RECORD OF TECHNICAL CHANGE

Technical Change No. 01 Page 1 of 4

Project/Job No. Industrial Sites/ DP04-010 Date: 4/13/04

Project/Job Name Corrective Action Investigation Plan for CAU 322: Areas 1 and 3 Release Sites and Injection Wells, Nevada Test Site, Nevada

The following technical changes (including justification) are requested by:

Robert F. Boehlecke	Task Manager
(Name)	(Title)

Description of Change

The following changes to the CAIP for CAU 322 are organized by subject matter. Changes 1, 2, and 3 present changes to the PALs for CAU 322. Changes 4 and 5 present changes to the CAU 322 sampling plan to clarify language used in the CAIP.

1. **Section 3.3 Preliminary Action Levels**. Replace the 5th bullet in the section with the following two bullets:

- "The PALs for radiological contaminants are based on the National Council on Radiation Protection and Measurement (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land use scenario (NCRP, 1999) scaled from 25- to 15-millirem (mrem) per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). The radiological PALs for the CAU 322 are listed in Table 3-4."
- "The PAL for tritium in soil is 400,000 pCi/L of soil moisture. The PAL is based on the NDEP approved *Underground Test Area Project Waste Management Plan* (NNSA/NSO, 2002) which specifies that fluids documented to be less than 20 times Nevada Drinking Water Standards (i.e., 20,000 pCi/L for tritium) can be discharged to an infiltration basin/area (NNSA/NSO, 2002c).

Replace existing Table 3-4 with the new attached Table 3-4.

2. **Section A.1.4.2 Determine the Basis for the Preliminary Action Levels**. Replace the 5th in the section with the following two bullets:

- "The PALs for radiological contaminants are based on the NCRP, Report No. 129, recommended screening limits for construction, commercial, industrial land use scenario (NCRP, 1999) scaled from 25- to 15-mrem per year dose, and, the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). The radiological PALs for the CAU 322 are listed in Table 3-4."

  Note: Potassium-40 will not be considered a COPC within the Gamma Spectrometry analysis.
- "The PAL for tritium in soil is 400,000 pCi/L of soil moisture. The PAL is based on the NDEP approved *Underground Test Area Project Waste Management Plan* (NNSA/NSO, 2002b) which specifies that fluids documented to be less than 20 times Nevada Drinking Water Standards (i.e., 20,000 pCi/L for tritium) can be discharged to an infiltration basin/area (NNSA/NSO, 2002c).

3. **Sections 8.0 and A.1.9 References**. Add the following references:

- National Council on Radiation Protection and Measurements. 1999. *Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies*, NCRP Report No. 129. Bethesda, MD.
- U.S. Department of Energy. 1993. "Radiation Protection of the Public and the Environment". DOE Order 5400.5, Change 2, January 7. Washington, D.C.
- U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002c. *Underground Test Area Project Waste Management Plan*, DOE/NV—343-Rev. 2. Las Vegas, NV.

4. Section 4.2.1.4 "Intrusive Investigation"; Subheading "Sampling at the Mud Plant AST Diesel Release, CAS 03-25-03"; Area A. Revise the 3rd sentence in the 4th paragraph (i.e., second paragraph on page 51 f 87)

   - Sentence currently reads "Samples will be collected at the 1- to 2-ft, 5- to 7-ft intervals, and at 2-ft intervals from 9- to 20-ft bgs." Revise sentence to read, "Samples will be collected for field screening at approximately the 1- to 2-ft, 5- to 7-ft intervals, and at 2-ft intervals from 9 to 20 ft bgs. Samples will be submitted to the laboratory based on the field-screening results, other biasing factors, and the discretion of the Site Supervisor.

5. Section 4.2.1.4 "Intrusive Investigation"; Subheading "Sampling at the Mud Plant AST Diesel Release, CAS 03-25-03"; Area B. Revise 3rd sentence of 2nd paragraph (i.e., last paragraph on page 51 of 87) and 1st sentence of 3rd paragraph (i.e., first paragraph on page 53 of 87)

   - Remove phrase "quick-turnaround" in 3rd sentence of 2nd paragraph
   - Remove the phrase "based on quick turn-around analysis and previous sampling results,"

Justification for change

1, 2, and 3) Through ongoing discussions between DOE and NDEP, it was determined that the PALs currently being used for the site investigations are not practical and should be replaced with dose-based action levels. In an agreement between NDEP and DOE (approved March 9, 2004), the PALs to be used for evaluating the potential radioactive contamination in soils will be based on an acceptable dose as specified by the NCRP Report No. 129 and the DOE 5400.5 guidance, rather than a comparison to background values. The use of the new radiological PALs has been accepted and approved for use in the planning and evaluation phase of the site investigations.

Potassium-40 (K-40) is a naturally occurring, unstable isotope of potassium with a half-life of 1.3 x 10E+09 years. The abundance of K-40 is approximately 0.0118% of natural potassium. Because of the high abundance of potassium in the environment, K-40 is the predominant radionuclide in soil, foods, and human tissues. The average human male contains approximately 100,000 pCi of K-40. The human body strictly regulates the potassium content within the body and is not influenced by variations in environmental levels. Therefore, the internal dose from K-40 remains constant.

Potassium-40 is not considered to be a contaminant of potential concern due to its predominance in the environment. In addition, the only mechanism for K-40 to be a contaminant is through concentration.

There are no reported activities at the NTS that would have concentrated K-40 or released it as a contaminant.

The CAU 322 CAI will not be expanded to delineate the extent of K-40, nor will K-40 be evaluated in the Corrective Action Decision Document.

Tritium is a COPC for CAS 03-20-05. The PAL established in the CAIP was set at the minimum detectable concentration (MDC) for tritium in soil (i.e., 1 pCi/g) and is not based on potential risk through applicable exposure pathways. The NCRP does not set a risk-based action level for tritium in soil; therefore, another published level was identified and selected. The UGTA discharge limit for tritium to an infiltration area/basin is based on levels negotiated with NDEP during development of the UGTA Fluid Management Plan (NNSA/NSO, 2002).

4) The sampling plan as currently written is unclear as to whether all intervals specified for collection at Area A of CAS 03-25-03 need to be submitted for laboratory analysis. As written, eight intervals per borehole will be sampled. Submittal of all eight intervals for laboratory analysis is not efficient. The change is being submitted to clarify that each interval will be field screened to help determine which intervals will be submitted for laboratory analysis.

5) Submittal of TPH samples for quick turn-around analyses is not necessary. The Site Supervisor can use biasing factors such as TPH field-screening results to determine when sampling from deeper intervals is necessary.

The project time will be <u>Unchanged</u>

Applicable Project-Specific Document(s): **Corrective Action Investigation Plan for Corrective Action Unit 322: Areas 1 and 3 Release Sites and Injection Wells, Nevada Test Site, Nevada Rev. 0, May 2003**

CC:

Approved By: Sabine Curtis Date 4-16-04
for Kevin Cabble, Acting Project Manager
Industrial Sites Project

for Robert M. Bangerter Jr. Date 4/16/04
Janet Appenzeller-Wing, Acting Division Director
Environmental Restoration Division

NDEP Concurrence Yes__ No__ Date ________
NDEP Signature ________
Contract Change Order Required Yes__ No__
Contract Change Order No. ________

Table 3-4
Requirements for Radionuclides in Solid Samples Collected at CAU 322

Radionuclide	Matrix	Analytical Method	MDC[a]	PAL[b]	Laboratory Precision	Percent Recovery
Gamma Spectrometry					Relative Percent Difference (RPD) 20% Water 35% Soil Normalized Difference (ND) –2<ND<2[e]	Laboratory Control Sample Recovery 80-120[f] Percent Recovery (%R) Chemical Yield 30-105[g]%R
Americium-241 (by Gamma Spectroscopy)	soil	HASL-300[d]	2.0 pCi/g[c]	7.62E+00		
Niobium-94	soil	HASL-300[d]	0.5 pCi/g[c]	2.43E+00		
Cesium-137	soil	HASL-300[d]	0.5 pCi/g[c]	7.30E+00		
Europium-152	soil	HASL-300[d]	4.0 pCi/g[c]	3.40E+00		
Europium-154	soil	HASL-300[d]	2.5 pCi/g[c]	3.24E+00		
Europium-155	soil	HASL-300[d]	1.0 pCi/g[c]	8.11E+01		
Cobalt-60	soil	HASL-300[d]	0.5 pCi/g[c]	1.61E+00		
Tritium	soil	Method 754/704[h]	1.0 E+03 pCi/L[i]	4.0 E+05 pCi/L[j]		
Other Radionuclides						
Uranium-234	soil	HASL-300[d]	0.05 pCi/g	8.59E+01		
Uranium-235	soil	HASL-300[d]	0.05 pCi/g	1.05E+01		
Uranium-238	soil	HASL-300[d]	0.05 pCi/g	6.32E+01		
Plutonium-238	soil	HASL-300[d]	0.05 pCi/g	7.78E+00		
Plutonium-239/240	soil	HASL-300[d]	0.05 pCi/g	7.62E+00		
Strontium-90	soil	HASL-300[d]	0.5 pCi/g	5.03E+02		

[a] MDC is the minimum detectable concentration. It is the lowest concentration of a radionuclide, if present in a sample, that can be detected with a 95 percent confidence level.

[b] The PALs for radiological contaminants are based on the NCRP, Report No. 129, recommended screening limits for construction, commercial, industrial land use scenario (NCRP, 1999) scaled from 25 to 15 mrem per year dose, and, the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

[c] MDCs vary depending on the presence of other gamma-emitting radionuclides in the sample.

[d] *Environmental Measurements Laboratory Procedures Manual*, HASL-300 (DOE, 1997)

[e] Normalized Difference (ND) is not RPD, it is another measure of precision used to evaluate duplicate analyses. The ND is calculated as the difference between two results divided by the square root of the sum of the squares of their total propagated uncertainties. *Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997)

[f] EPA *Contract Laboratory Program Statement of Work for Inorganic Analysis* (EPA, 1988a; 1994b; and 1995)

[g] *General Radiochemistry and Routine Analytical Services Protocol (GRASP)* (EG&G Rocky Flats, 1991). The chemical yield only applies to uranium and strontium.

[h] Based on Paragon Analytics, Inc. Method 754/704 (PAI, 1999). Other laboratory specific methods may be substituted.

[i] The MDC for tritium in soil moisture may vary depending on the percent moisture in the soil samples submitted.

[j] Units of pCi/L will be calculated based on the result for pCi/g and percent soil moisture as calculated by the laboratory. The PAL for tritium is based on the UGTA Project limit of 400,000 pCi/L for discharge of water containing tritium to an infiltration basin/area (NNSA/NSO, 2002).

Definitions:
pCi/g = Picocuries per gram
pCi/L = Picocuries per liter

395-0366

20x drinking Water Standard

RECORD OF TECHNICAL CHANGE

Technical Change No. 01 Page 1 of 4

Project/Job No. Industrial Sites/ DP04-010 Date: 4/13/04

Project/Job Name Corrective Action Investigation Plan for CAU 322: Areas 1 and 3 Release Sites and Injection Wells, Nevada Test Site, Nevada

The following technical changes (including justification) are requested by:

Robert F. Boehlecke (Name) Task Manager (Title)

Description of Change

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4) The sampling plan as currently written is unclear as to whether all intervals specified for collection at Area A of CAS 03-25-03 need to be submitted for laboratory analysis. As written, eight intervals per borehole will be sampled. Submittal of all eight intervals for laboratory analysis is not efficient. The change is being submitted to clarify that each interval will be field screened to help determine which intervals will be submitted for laboratory analysis.

5) Submittal of TPH samples for quick turn-around analyses is not necessary. The Site Supervisor can use biasing factors such as TPH field-screening results to determine when sampling from deeper intervals is necessary.

The project time will be <u>Unchanged</u>

Applicable Project-Specific Document(s): **Corrective Action Investigation Plan for Corrective Action Unit 322: Areas 1 and 3 Release Sites and Injection Wells, Nevada Test Site, Nevada Rev. 0, May 2003**

CC:

Approved By: for Sabine Curtis Date 4-16-04
Kevin Cabble, Acting Project Manager
Industrial Sites Project

for Robert M. Bangerter Date 4/16/04
Janet Appenzeller-Wing, Acting Division Director
Environmental Restoration Division

NDEP Concurrence [✓ Yes] No__ Date 4/30/04
NDEP Signature ____________
Contract Change Order Required Yes__ No____
Contract Change Order No. ____________

Attachment to ROTC #1 for CAIP for CAU 322

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Table 3-4
Requirements for Radionuclides in Solid Samples Collected at CAU 322

Radionuclide	Matrix	Analytical Method	MDC[a]	PAL[b]	Laboratory Precision	Percent Recovery
Gamma Spectrometry						
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Plutonium-238	soil	HASL-300[d]	0.05 pCi/g	7.78E+00		
Plutonium-239/240	soil	HASL-300[d]	0.05 pCi/g	7.62E+00		
Strontium-90	soil	HASL-300[d]	0.5 pCi/g	6.03E+02		

[a] MDC is the *minimum detectable concentration*. It is the lowest concentration of a radionuclide, if present in a sample, that can be detected with a 95 percent confidence level.

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[c] MDCs vary depending on the presence of other gamma-emitting radionuclides in the sample.

[d] *Environmental Measurements Laboratory Procedures Manual*, HASL-300 (DOE, 1997)

[e] Normalized Difference (ND) is not RPD, it is another measure of precision used to evaluate duplicate analyses. The ND is calculated as the difference between two results divided by the square root of the sum of the squares of their total propagated uncertainties. *Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997)

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Definitions:
pCi/g = Picocuries per gram
pCi/L = Picocuries per liter

Nevada
Environmental
Restoration
Project

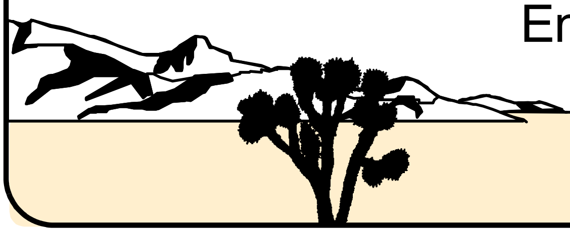
DOE/NV--901

Corrective Action Investigation Plan for Corrective Action Unit 322: Areas 1 and 3 Release Sites and Injection Wells, Nevada Test Site, Nevada

Controlled Copy No.: ___
Revision No.: 0

July 2003

Approved for public release; further dissemination unlimited.



Environmental Restoration
Division

U.S. Department of Energy
National Nuclear Security Administration
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CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 322: AREAS 1 AND 3 RELEASE SITES AND INJECTION WELLS, NEVADA TEST SITE, NEVADA

U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Las Vegas, Nevada

Controlled Copy No.: ___

Revision No.: 0

July 2003

Approved for public release; further dissemination unlimited.

CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 322: AREAS 1 AND 3 RELEASE SITES AND INJECTION WELLS, NEVADA TEST SITE, NEVADA

Signature Approved
Approved by:______________________________ Date: 6/25/03

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Signature Approved
Approved by:______________________________ Date: 6/25/03

Runore C. Wycoff, Division Director
Environmental Restoration Division

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List of Acronyms and Abbreviations

ACM	Asbestos-containing material
AEC	U.S. Atomic Energy Commission
Am	Americium
AST	Aboveground storage tank
ASTM	American Society of Testing and Materials
bgs	Below ground surface
BN	Bechtel Nevada
BOP	Blowout Preventer
CADD	Corrective Action Decision Document
CAI	Corrective action investigation
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CLP	Contract Laboratory Program
CFR	*Code of Federal Regulations*
COC	Contaminant of concern
COPC	Contaminant of potential concern
CR	Closure Report
CRDL	Contract-required detection limit
CRQL	Contract-required quantitation limits
Cs	Cesium
CSM	Conceptual site model
CSSA	Contaminated Soil Storage Area
DOE	U.S. Department of Energy

Acronyms and Abbreviations *(Continued)*

DOT	U.S. Department of Transportation
dpm/100 cm^2	Disintegrations per minute per 100 square centimeters
DQI	Data quality indicator
DQO	Data quality objective
DRO	Diesel-range organics
EM	Electromagnetic
EPA	U.S. Environmental Protection Agency
EPD	Environmental Protection Division
FADL	Field activity daily log
FFACO	*Federal Facility Agreement and Consent Order*
FSL	Field-screening level
FSR	Field-screening results
ft	Foot (feet)
ft^2	Square feet
ft^3	Cubic feet
gal	Gallon
GPR	Ground-penetrating radar
GPS	Global positioning system
GRO	Gasoline-range organics
HASP	Health and Safety Plan
HWAA	Hazardous Waste Accumulation Area
IDW	Investigation-derived waste
in.	Inch(es)

Acronyms and Abbreviations *(Continued)*

IRIS	Integrated Risk Information System
ISMS	Integrated Safety Management System
IW	Injection well
LANL	Los Alamos National Laboratory
LAPS	Los Alamos Post Shot
LCSD	Laboratory control sample duplicate
LCS	Laboratory control sample
MDA	Minimum detectable activity
MDC	Minimum detectable concentration
mg/L	Milligrams per liter
mg/kg	Milligrams per kilogram
mi	Mile
MRL	Minimum reporting limit
MS	Matrix spike
MSD	Matrix spike duplicate
M&O	Management and Operating
NAC	*Nevada Administrative Code*
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection
NEPA	*National Environmental Policy Act*
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NOAA	National Oceanic and Atmospheric Administration
NRDS	Nuclear Rocket Development Station

Acronyms and Abbreviations *(Continued)*

NTS	Nevada Test Site
NTSWAC	*Nevada Test Site Waste Acceptance Criteria*
PA	Preliminary assessment
PAH	Polynuclear aromatic hydrocarbons
PAL	Preliminary action level
PCB	Polychlorinated biphenyls
pCi/g	Picocuries per gram
pCi/L	Picocuries per liter
PID	Photoionization detector
PPE	Personal protective equipment
ppm	Parts per million
PRG	Preliminary remediation goal
Pu	Plutonium
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RCA	Radiologically controlled area
RCRA	*Resource Conservation and Recovery Act*
RESRAD	Residual Radiation
RMA	Radioactive materials area
ROTC	Record of technical change
RPD	Relative percent difference
RWMS	Radioactive Waste Management Site
SAA	Satellite accumulation area

Acronyms and Abbreviations *(Continued)*

SDWS	*Safe Drinking Water Standards*
Sr	Strontium
SSHASP	Site-specific health and safety plan
SNPO	Space Nuclear Propulsion Office
SVOC	Semivolatile organic compounds
SW	Solid waste
TCC	Test Cell C
TCL	Target compound list
TCLP	Toxicity characteristic leaching procedure
TNT	Transient Nuclear Test
TPH	Total petroleum hydrocarbon
TSCA	*Toxic Substance Control Act*
U	Uranium
UGTA	Underground Test Area
USGS	U.S. Geological Survey
UST	Underground storage tank
VOC	Volatile organic compounds
%R	Percent recovery
µCi/g	Microcuries per gram
µg/L	Micrograms per liter

Executive Summary

This Corrective Action Investigation Plan contains information for conducting site investigation activities at Corrective Action Unit (CAU) 322: Areas 1 & 3 Release Sites and Injection Wells, Nevada Test Site, Nevada. This information includes facility descriptions, environmental sample collection objectives, and data evaluation criteria. The results of the field investigation will support a defensible evaluation of corrective action alternatives that will be presented in the Corrective Action Decision Document.

Corrective Action Unit 322 is comprised of three Corrective Action Sites (CASs) in Areas 1 & 3 of the Nevada Test Site (NTS), as presented below:

- CAS 01-25-01, AST Release (Area 1)
- CAS 03-25-03, Mud Plant AST Diesel Release (Area 3)
- CAS 03-20-05, Injection Wells (Area 3)

Corrective Action Site 01-25-01, AST Release, consists of a gravel containment pit for a former aboveground storage tank (AST).

Corrective Action Site 03-25-03, Mud Plant AST Diesel Release, was divided into parcels A and B because there are two separate and distinct releases and transport mechanisms associated with this CAS as shown in Table ES.1-1.

Corrective Action Site 03-20-05, Injection Wells, includes the Blowout Preventer (BOP) Shop Building, three below grade holding tanks, and an injection well. The Blowout Preventer Shop structure is located in the Los Alamos National Laboratory (LANL) Post Shot Yard and is identified in the NTS Facilities and Infrastructure Database as Building 03-3C-02 (Post Shot Shop). Markings on the side of the building indicated it is the Los Alamos Post Shot (LAPS) Building. For the purpose of this document, the building will be referred to as the BOP Shop. The injection well is located east of the BOP Shop and consists of a below grade well vault and injection well. The design of the well vault and the injection well allowed for the separation of liquid-phase product from discharged wastewater. As the level of the wastewater rose within the vault, the lighter separate phase product would discharge into the injection well and the remaining wastewater was allowed to infiltrate into the soil below the well vault. In this respect, the well vault resembled an oil/water separator and a dry well. While the three below grade tanks at the BOP Shop have historically been referred to as holding tanks, they meet the current definition of underground storage tanks (USTs) (*Nevada Administrative Code* 459.9929 [NAC, 2002f], which adopts the 40 *Code of Federal Regulations* 280.12 definition [CFR, 2002a]). This regulation states that USTs and their associated piping will be part of the UST system. Therefore, for the purpose of this investigation, the three holding tanks and associated piping described at CAS 03-20-05 will be treated as USTs.

Table ES.1-1
CAU 322 CASs and Associated Releases and Conceptual Site Models

Corrective Action Site	Releases Associated with CAS	Conceptual Site Model(s)
CAS 01-25-01 **CAS 03-25-03**	Fuel spill due to overfilling of motor vehicle fuel tanks, filling of aboveground storage tanks, leakage of fuel piping, and possible fuel spill(s) during filing of diesel generators	Surface discharge, subsurface residual contamination
CAS 03-25-03	Buried residual contamination associated with diesel fuel releases at the former Mud Plant	Buried total petroleum hydrocarbon contamination
CAS 03-20-05	Well vault discharges associated with the infiltration of wastewater from the Blowout Preventer Shop	Residual contamination in the well vault structure and in the underlying soil
CAS 03-20-05	Discharge to injection well, potential for leakage from holding tanks and sumps into underlying media and potentially groundwater	Residual contamination in the injection well and sumps migrating downward due to gravity
CAS 03-20-05	Migration of surface contamination from building structure to surrounding soil and possible leakage of wastewater from disconnects and leaks from the buried piping	Residual contamination in the surface soil

Two conceptual site models (CSMs) were developed for CAU 322 to address all releases associated with the three CASs. Surface/Near-Surface CSM #1 represents the release and transport of potential contaminants at the surface. Deep Injection CSM #2 represents the release and transport of contaminants into the deep subsurface.

The data quality objective (DQO) process was used to identify and define the type, quantity, and quality of data needed to complete the investigation phase of the corrective action process. The DQOs address the primary problem that sufficient information was not available to determine the appropriate corrective action for the site. To be able to determine the corrective action alternative, two critical decisions were defined:

1. Does contamination from any of the releases exceed preliminary action levels?
2. Is the extent of contamination above action levels sufficiently delineated to determine potential waste volumes?

For the purpose of determining distinct data needs, resolution of the first decision is addressed as Phase I and resolution of the second decision is addressed as Phase II. Phase I data will be generated and evaluated at each CAS. Phase II data will be generated and evaluated for each CAS with at least one contaminant exceeding preliminary action levels. Corrective action closure alternatives (i.e., no further action, closure in place, or clean closure) will be recommended for each CAS based on an evaluation of all the DQO-required data.

Based on existing data and process knowledge, the contaminants of potential concern for CAU 322 include volatile organic compounds, semivolatile organic compounds, petroleum hydrocarbons, polychlorinated biphenyls, metals, and radionuclides.

The general technical approach for investigation of CAU 322 will consist of the following activities:

- Perform radiological surveys.
- Collect environmental soil samples and submit for laboratory analysis to determine if contaminants of concern are present. In general, field activities will consist of collecting soil samples at biased locations according to approved procedures.
- Collect required quality control samples.
- Collect additional environmental soil samples to define the lateral and vertical extent of contaminants of concern, if necessary.

All waste generated during this investigation will be managed under applicable federal, state, and local regulations, agreements, and requirements. Investigation-derived waste soil will be returned to the site sample locations pending corrective action decisions.

This Corrective Action Investigation Plan has been developed in accordance with the *Federal Facility Agreement and Consent Order* that was agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense. Under the *Federal Facility Agreement and Consent Order*, this CAIP will be submitted to the Nevada Division of Environmental Protection for approval. Fieldwork will be conducted following approval of this plan.

1.0 Introduction

This Corrective Action Investigation Plan (CAIP) contains project-specific information including facility descriptions, environmental sample collection objectives, and criteria for conducting site investigation activities at Corrective Action Unit (CAU) 322: Areas 1 & 3 Release Sites and Injection Wells at the Nevada Test Site (NTS), Nevada.

This CAIP has been developed in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (1996) that was agreed to by the State of Nevada, the U.S. Department of Energy (DOE), and the U.S. Department of Defense (DoD).

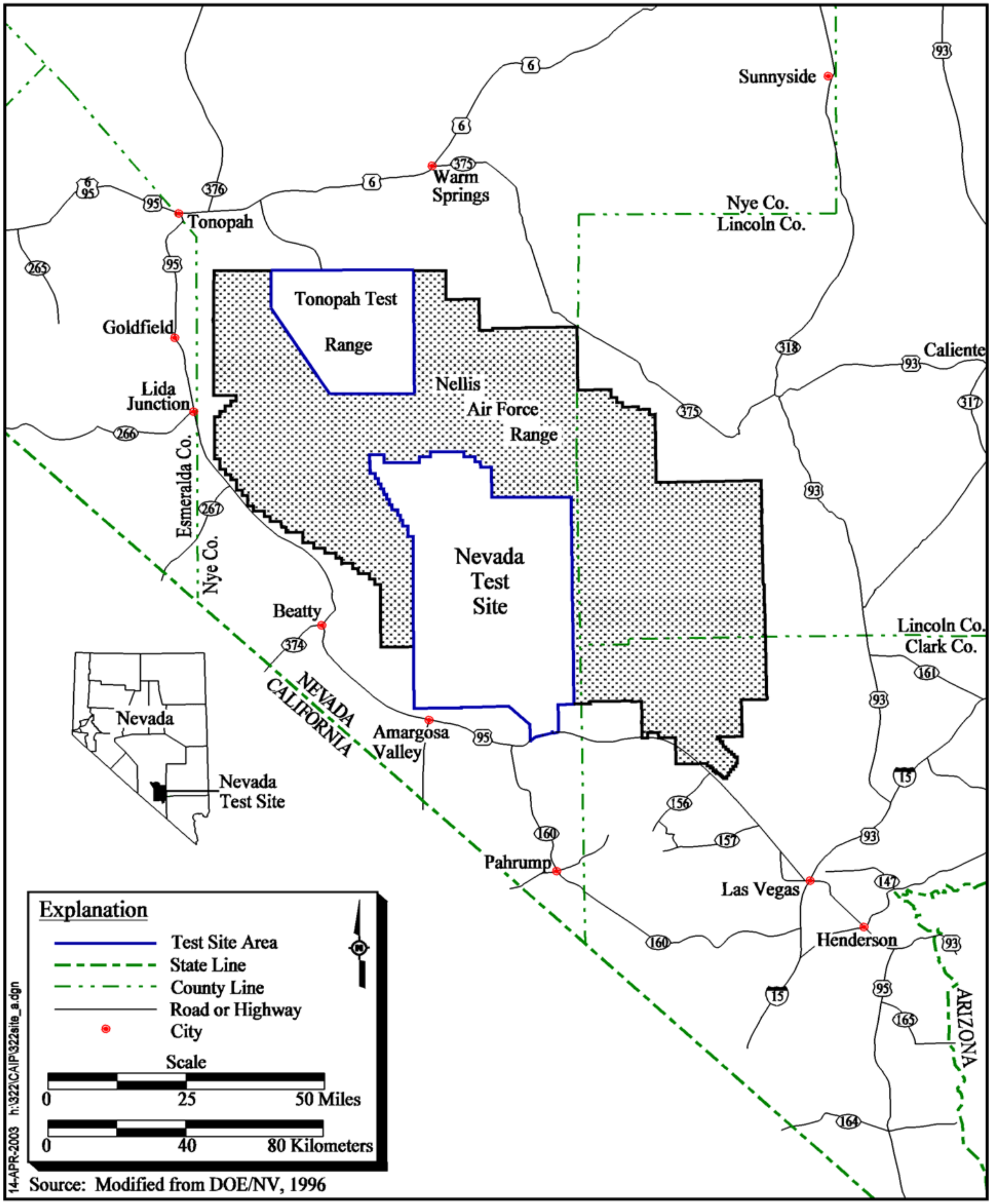
The NTS is approximately 65 miles (mi) northwest of Las Vegas, Nevada (Figure 1-1). Corrective Action Unit 322 is comprised of three corrective action sites (CASs) located in Areas 1 and 3 of the NTS as shown in Figure 1-2. One CAS is in Area 1 and the remaining two CASs are in Area 3 and are identified below:

- CAS 01-25-01 - AST Release (Area 1)
- CAS 03-25-03 - Mud Plant AST Diesel Release (Area 3)
- CAS 03-20-05 - Injection Wells (Area 3)

Corrective Action Unit 322 is being investigated because existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives. Therefore, additional information will be obtained by conducting a corrective action investigation (CAI) prior to evaluating corrective action alternatives and selecting the appropriate corrective action for each CAS. The CAI will include site inspections; subsurface explorations; field screening for selected parameters; and laboratory analysis of surface, shallow subsurface, and deep subsurface soil where appropriate. Data will also be obtained to support investigation-derived waste (IDW) disposal and future waste management decisions.

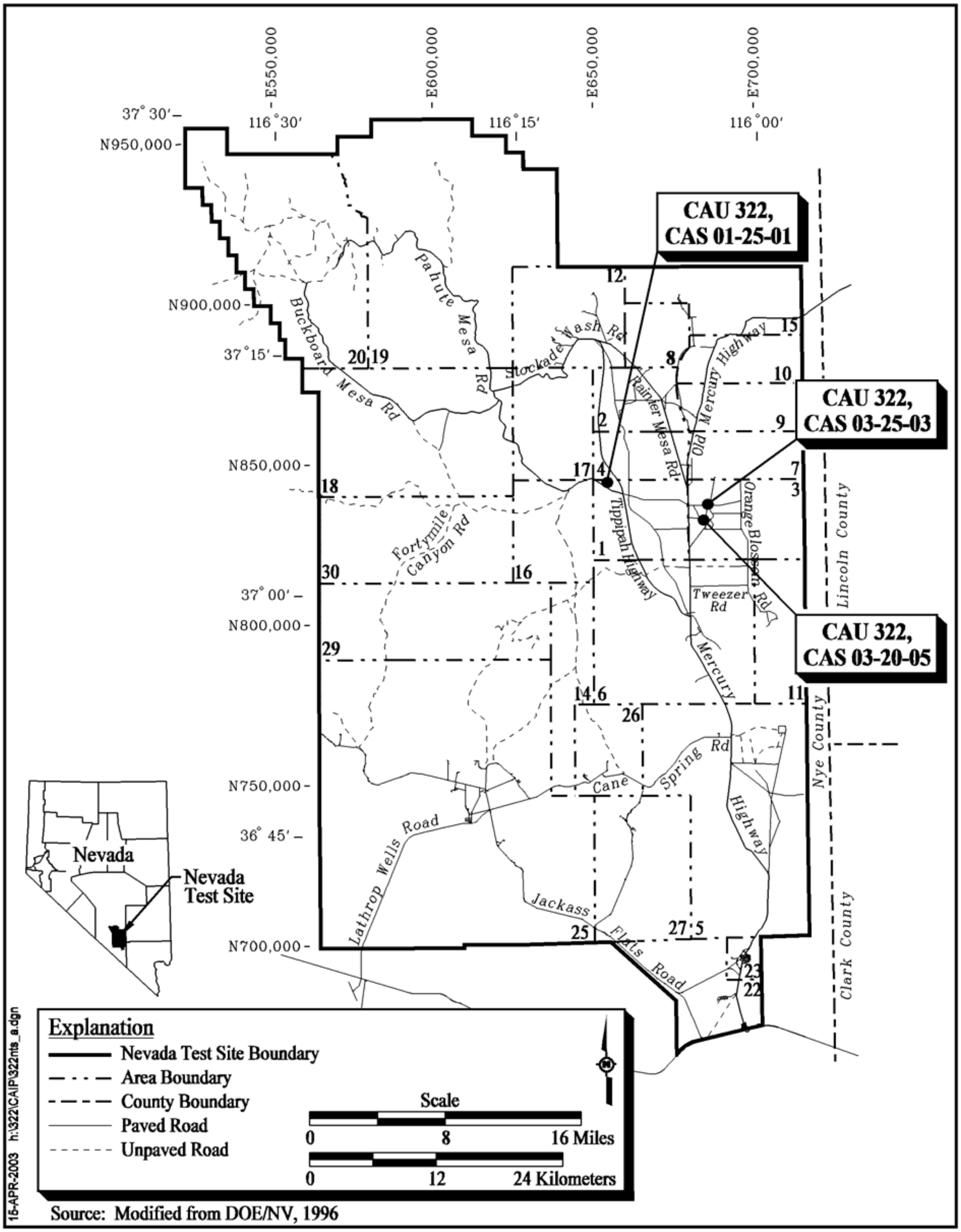
1.1 Purpose

The three CASs in CAU 322 are being investigated because hazardous and/or radioactive constituents may be present at concentrations and locations that could potentially pose a threat to human health and the environment.



Source: Modified from DOE/NV, 1996

Figure 1-1
Nevada Test Site Location Map



Source: Modified from DOE/NV, 1996

Figure 1-2
Corrective Action Unit 322 Location Map

Brief History of the CASs in CAU 322

Corrective Action Site 01-25-01 consists of a gravel containment pit for a former aboveground storage tank (AST). The AST supplied diesel oil for the Area 1 Shaker Plant. The Shaker Plant produced gravel materials used during underground experiments at the NTS. Currently the Shaker Plant is deactivated.

Corrective Action Site 03-25-03 is located at the Area 3 Mud Plant. The Mud Plant produced drilling mud for the underground experiments. Operation of the Mud Plant began in the early 1960s and the plant was deactivated in the late 1980s. Corrective Action Site 03-25-03 is an investigation of multiple diesel fuel releases at the Mud Plant facility. The CAS is divided into parcels A and B because there are two separate and distinct release areas.

Corrective Action Site 03-20-05 includes the Blowout Preventer (BOP) Shop Building, three below grade holding tanks, and an injection well located in Area 3 Camp of the NTS. The BOP Shop was used for the decontamination of drilling equipment. Operations of the BOP Shop were active during the 1980s and the facility was deactivated in 1989. Corrective Action Site 03-20-05 is an investigation of the decontamination procedures at the BOP Shop and the reported release of wastewater to an unpermitted injection well.

1.1.1 Data Quality Objectives Summary

The planned investigation for CAU 322 is guided by the data quality objectives (DQOs) developed by representatives of the Nevada Division of Environmental Protection (NDEP) and the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO). The DQOs are used to identify and define the type, amount, and quality of data needed to develop and evaluate appropriate corrective actions for CAU 322.

The DQO strategy for CAU 322 is as follows:

- Determine if a significant contaminant transport mechanism (e.g., contaminant infiltration, vapor transport, or other mechanism) is present in subsurface soil.

- Determine if significant contaminant migration has occurred in the surface soil, in the near-surface soil, and in the deep subsurface soil.

- Determine the extent of contamination if contamination migration has occurred.

A summary of the results of the DQO process is provided in Section 3.4 and a detailed discussion of the DQO process is included in Appendix A.1.

The primary question for the investigation is, "Are chemical and radionuclide constituents present in the surface at concentrations that pose an unacceptable risk to human health or the environment, and if present, have these chemicals migrated into the shallow subsurface. In addition, are data sufficient to evaluate appropriate corrective actions?" To address these questions, resolution of two decisions statements is required:

- Decision I is to "Identify the contamination" by identifying contaminant concentrations above the preliminary action levels (PALs). Analytical data must be collected from areas most likely to contain contamination resulting from site activities, and parameters must be selected that represent the types of potential contamination present. If PALs are not exceeded, the investigation is complete. If PALs are exceeded, then Decision II must be resolved.

- Decision II is, "Determine the extent of contamination identified above PALs." This decision will be achieved by the collection of data that are adequate to define the extent of contaminants of concern (COCs).

In addition, data will be obtained to support IDW disposal and future waste management decisions.

Most of the data will be generated from the analysis of environmental samples collected during the CAI. The general purpose of the investigation is to:

- Identify the presence and nature of COCs.

- Determine the vertical and lateral extent of identified COCs.

- Ensure that all NDEP, *Resource Conservation and Recovery Act* (RCRA), and DOE closure requirements have been met.

1.2 Scope

To generate information needed to resolve the decision statements identified in the DQO process, the scope of the CAI for CAU 322 includes the following activities:

- Conduct land radiological surveys at CAS 03-25-03, Mud Plant AST Diesel Release, and CAS 03-20-05, Injection Wells, over the areas of highest probable deposition from previous site use.
- Conduct field-screening activities to determine sample intervals.
- Collect and submit environmental samples for laboratory analyses to determine if COCs are present.
- Collect additional environmental samples if COCs are present, and submit for laboratory analyses to define the vertical and lateral extent of the contamination.
- Collect quality control (QC) samples for laboratory analyses to evaluate the performance of measurement systems and controls based on the requirements of the data quality indicators (DQIs).
- Collect samples of IDW, as necessary, and conduct inspections and surveys, as needed, to support waste management decisions and to promote waste minimization.
- Collect soil samples for laboratory analysis of geotechnical parameters and/or bioassessment, as necessary.

1.3 CAIP Contents

This CAIP includes the following sections and information:

Section 1.0 - Introduction presents the purpose and scope of this CAIP.

Section 2.0 - Facility Description provides the background information for the CAU.

Section 3.0 - Objectives include the conceptual site models (CSMs).

Section 4.0 - Field Investigation presents the planned field sampling activities and CAS diagrams.

Section 5.0 - Waste Management issues are discussed.

Section 6.0 - Quality Assurance (QA)/QC presents general field and laboratory QA and QC issues (including collection of QC samples).

Section 7.0 - Duration and Records - Availability presents project schedule and records availability.

Section 8.0 - References lists the documents cited.

Appendix A.1 - DQO Summary

Appendix A.2 - Project Organization

Appendix A.3 - NDEP Comment Responses

Public involvement activities are documented in the "Public Involvement Plan," Appendix V, of the FFACO (1996). The managerial aspects of this project are discussed in the *Project Management Plan* (DOE/NV, 1994) and will be supplemented with a site-specific field management plan that will be developed prior to field activities. Additional QA/QC requirements are presented in the *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002a). The health and safety aspects of this project are documented in a contractor-specific health and safety plan (HASP) and will be supplemented with a site-specific health and safety plan (SSHASP) written prior to the start of field work.

2.0 Facility Description

The CASs were grouped into CAU 322 based on their geographical location, technical similarities, and agency responsible for closure.

2.1 Physical Setting

Areas 1 and 3 are located in the east-central portion of the NTS. The following sections provide a general overview of the topography, geology, and hydrology pertaining to the two areas. General background information pertaining to topography, geology, hydrogeologic, and climatology are provided for these specific areas of the NTS region as described in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV, 1996). The location of each CAS on the NTS is shown on Figure 1-2.

Most of Areas 1 and 3, including CASs 01-25-01, 03-25-03, and 03-20-05, are located in the intermontane basin of Yucca Flat, a topographically closed valley on the eastern side of the NTS (LLNL, 1982). Yucca Flat is an internal draining, north-south trending valley and is bounded on the north by Quartzite Ridge; on the east by Halfpint Range; on the south by Yucca Lake, Mine Mountain, CP Hills, and Massachusetts Mountain; and on the west by Rainier Mesa, Eleana Range, and Shoshone Mountain.

Surficial sediments consist of Quaternary and Tertiary valley-fill alluvium derived from the surrounding mountains, which are composed of Paleozoic carbonates and clastics and tertiary volcanics. These quaternary/Tertiary alluvial strata occur within fault-bounded troughs above the underlying Tertiary volcanic section. The average thickness of this alluvium material is approximately 980 feet (ft), although in some places it is as thick as 6,560 ft. The alluvium is made up of gravel and poorly sorted sands with intermittent silt beds (LLNL, 1982).

Areas 1 and 3 are located in Ash Meadow Groundwater Basin where groundwater generally moves downward through alluvium and volcanic rocks to a Paleozoic carbonate aquifer. Groundwater generally flows southwest and discharges at the large springs in Ash Meadows, about 25 mi southwest of Mercury, Nevada (Winograd and Thordarson, 1975).

The UE-16d Eleana Water Well is the closest to CAS 01-12-01 and is located approximately 7,870 ft west of the site. The well was drilled to a depth of about 3,000 ft with a static water level of approximately 750 ft below ground surface (bgs) (Dinwiddie and Weir, 1979).

The U.S. Geological Survey (USGS) Water Well A is the closest water well to CAS 03-25-03 and CAS 03-20-05. Well A is located near the Area 3 Camp approximately 4,500 ft southwest of the Mud Plant and approximately 390 ft northeast of CAS 03-20-05. Well A supplied all of the water for the Mud Plant in the 1960s and also provided domestic water for the Area 3 Camp prior to 1991 (Wueller, 1994). Currently, Well A is inactive and considered a testing well. The well is about 1,870 ft deep, and the depth to groundwater is approximately 1,610 ft bgs (USGS, 2002).

Average annual precipitation in the eastern portion of the NTS has been measured at the National Oceanic and Atmospheric Administration (NOAA) Air Research Laboratory Special Operations and Research Division gauging station between 1958 and 2002. The gauging station is located at 36° 47′ 05″ North longitude and 116° 17′ 20″ West latitude within Area 25 of the NTS. The average annual precipitation reported during this 44-year period is 5.54 inches (in.) with annual averages ranging from 0.98 in. in 1959 to 14.40 in. in 1998 (ARL, 2003).

The native ground surface was disturbed during the construction of the BOP Shop in Area 3 and at the Mud Plant. Evidence of fill placement was observed along the perimeter of the former building foundation and in the facility yard and roadway areas. In general, the surface areas of CASs 03-25-03 and 03-20-05 were leveled and capped with pea-gravel type material. The containment pit at CASs 01-25-01, Area 1 Shaker Plant AST, is constructed entirely of graded gravel (IT, 2002).

2.2 Operational History

The following subsections provide a description of the use and history of each CAS in CAU 322 that may have resulted in a potential release to the environment. The section begins with a general discussion of the area, narrowing the discussion to a facility or landmark, and finally focusing on an individual CAS. This CAS-specific summary is designed to illustrate all significant known activities.

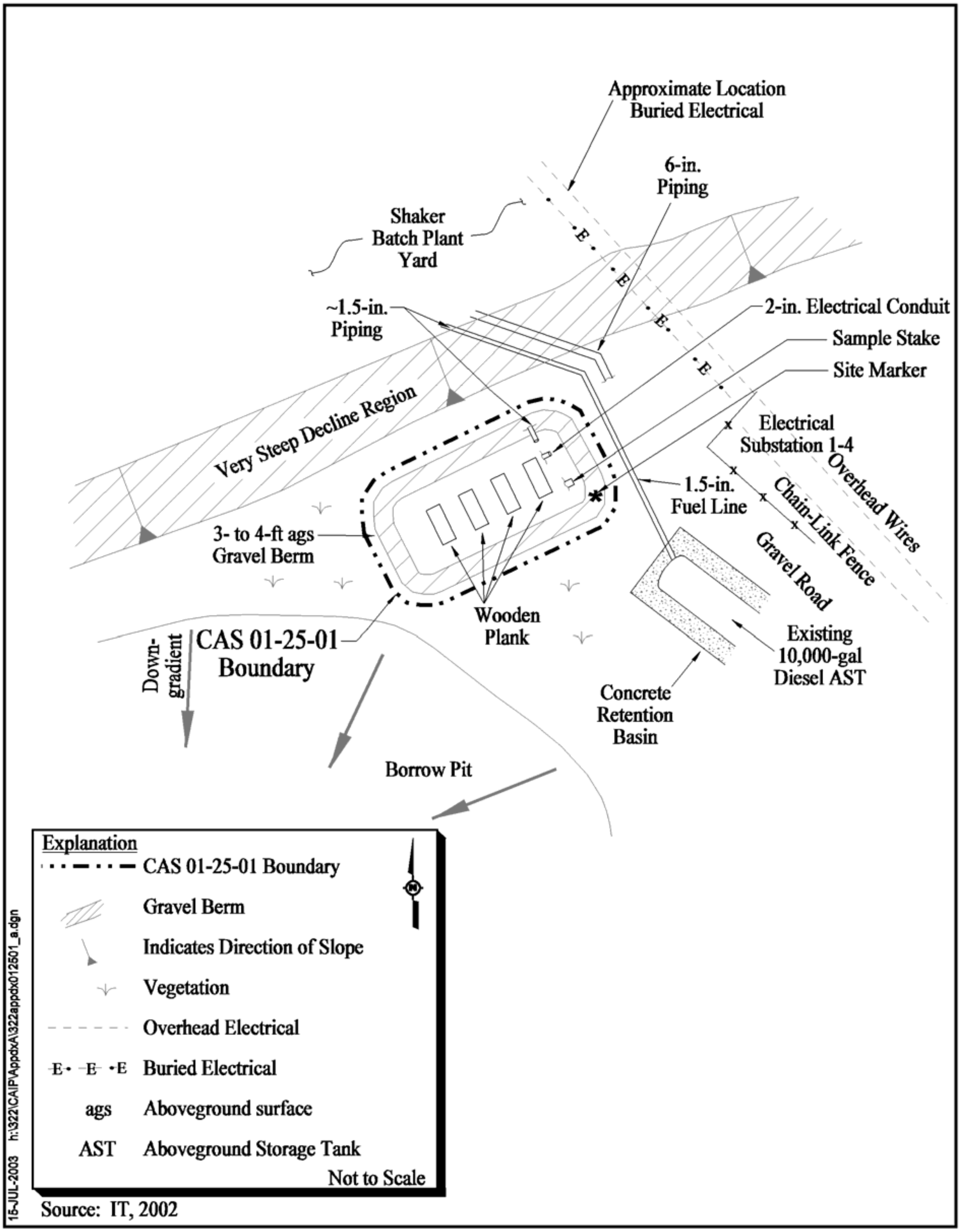
2.2.1 CAS 01-25-01, AST Release

Physical Setting and Operational History - CAS 01-25-01 is a 27- by 60-ft gravel containment pit with bermed walls located at the top edge of a bluff overlooking the Area 1 Shaker Plant. Four wooden planks partially line the bottom of the pit. The gravel structure was constructed as a containment pit for an aboveground storage tank (AST). The tank had a capacity of 10,000 gallons (gal) and was reported to store diesel fuel for the Shaker Plant. The Area 1 Shaker Plant produced gravel material used to stem boreholes during underground experiments at the NTS. Facility was active through the 1980s; the facility is currently inactive (Figure 2-1).

The gravel containment pit is located approximately 25 ft north of Electrical Substation 1-4. An existing AST is located approximately 40 ft southeast of the CAS. In addition, a partially buried 1.5-in. steel fuel line is located approximately 15 ft northeast of the CAS. The fuel line appears to supply the Shaker Plant with diesel fuel. An electrical conduit with wire leads was observed in the southern end of the gravel containment area. In addition, a portion of steel pipe was observed protruding through the east gravel containment berm. The pipe appeared to be part of an abandoned fuel line. No historical information is available that identifies a release of petroleum product at the site. Evidence of staining (e.g., fuel oil) was not observed within the CAS. A wooden sample marker stake (ERS 00179) was located in the northern portion of the gravel containment area.

2.2.2 CAS 03-25-03, Mud Plant AST Diesel Release

Physical Setting and Operational History - CAS 03-25-03 is located within the former Mud Plant facility at the northwest corner of the intersection of Road 3-03 and Blast Line Road in the former Area 3 Camp. The Mud Plant facility began operation in February 1962 and was used to formulate mud mixtures in support of drilling operations for the Underground Test Area (UGTA) program. Operation of the Mud Plant facility ceased in December 1995. An AST containing fuel oil and a fuel dispensing station were located approximately 350 ft west of the Mud Plant. Available records indicated the AST had a capacity of approximately 10,000 gal and was located in a gravel containment pit. Aerial photos indicate the fuel dispensing station was located south of the AST. Information was not available regarding the type of equipment or physical condition of the fuel dispensing station. The AST and fuel station were removed; however, the date of the removal was not available.



Source: IT, 2002

Figure 2-1
CAS 01-25-01, Site Plan of AST Release

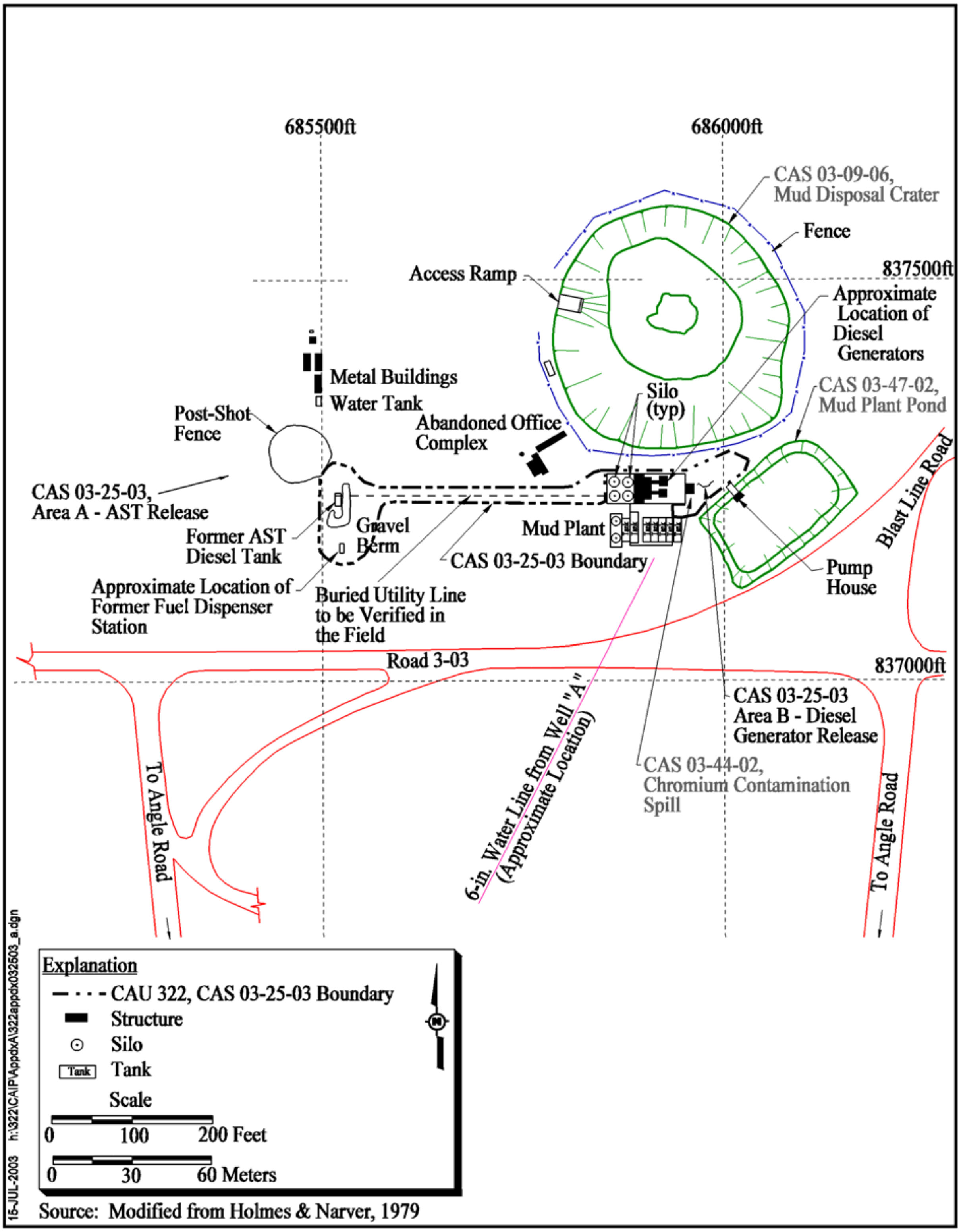
The CAS includes a fuel spill area consisting of a bermed gravel containment where a former diesel AST once resided, all affected soil following a speculative pathway proceeding east and downgradient approximately 500 ft along the northern side of the Mud Plant, and an open gravel access area along the east side of the Mud Plant building. The boundaries of this CAS intersect with those of CAU 34, CAS 03-44-01, at the east side of the Mud Plant building, but the extent of intersection is uncertain. Figure 2-2 shows the CAS boundaries as identified in preliminary assessment site visits, documentation records, and aerial photographs.

2.2.3 CAS 03-20-05, Injection Wells

Physical Setting and Operational History - CAS 03-20-05 includes the BOP Shop Building, three below grade holding tanks, and an injection well. The BOP Shop structure is located in the Los Alamos National Laboratory (LANL) Post Shot Yard and is identified in the NTS Facilities and Infrastructure Database as Building 03-3C-02 (Post Shot Shop). Markings on the side of the building indicated it is the Los Alamos Post Shot (LAPS) Building. For the purpose of this document, the building will be referred to as the BOP Shop (BN, 2002).

There are three below grade holding tanks located in the interior of the BOP Shop. While the three below grade tanks at the BOP Shop have historically been referred to as holding tanks, they meet the current definition of underground storage tanks (USTs) (*Nevada Administrative Code* [NAC] 459.9929, which adopts the 40 *Code of Federal Regulations* [CFR] 280.12 definition). This regulation states that USTs and their associated piping will be part of the UST system. Therefore, for the purpose of this investigation, the three holding tanks and associated piping described at CAS 03-20-05 will be treated as USTs.

An injection well is located to the east of the BOP Shop and consists of a below grade well vault and injection well. The design of the well vault and the injection well allowed for the separation of liquid-phase product from discharged wastewater. As the level of the wastewater rose within the vault, the lighter separate phase product would discharge into the injection well and the remaining wastewater was allowed to infiltrate into the soil below the well vault. In this respect, the well vault resembled an oil/water separator and a dry well.



Source: Modified from Holmes & Narver, 1979

Figure 2-2
CAS 03-25-03, Site Plan of Mud Plant AST Diesel Release

The BOP Shop is a two-story, metal frame building with a concrete slab floor. The central portion of the building is a two-story work area with overhead, roll-up doors on the north and south sides of the building. An office area occupies the first floor along the west side of the building, and an equipment storage area is located on a mezzanine level above the office. Site investigators did not observe any bathroom facilities or the presence of floor drains. Three below grade holding tanks are located in the interior of the building at the northern end. A below grade conduit pipe chase was observed across the south sides of the three holding tanks and extended along the east side of the building floor. The holding tanks and the pipe chase were covered with steel plates. Several hydraulic lines, electrical conduit, and compressed air lines and associated controls were located on the east wall of the building. A 5-ton overhead hoist is mounted on twin overhead rails extending between the front and rear of the building.

The top of each holding tank is flush with the floor and each holding tank has a diameter of approximately 8 ft and depth of about 7 ft. At the center of each holding tank is a sump, which extends to a depth of approximately 35 ft bgs. The sump is constructed of a hollow steel casing and extends approximately 18 in. above the bottom of the tank floor. A flange is fitted to the top of the casing. The sides of the holding tanks are steel and the floor is poured concrete. A steel plate (level with the building floor) covers the top of each holding tank. Documentation indicated that the sumps beneath the holding tanks were sealed.

An injection well is housed within a circular, steel protective shelter located about 75 ft east of the BOP Shop and adjacent to the building foundations and floor slab of the Linesman Shop building which has been demolished. Available documentation indicated the injection well has a diameter of approximately 7-in. and has a depth of about 100 ft bgs. However, information presented at the DQO meeting on February 10, 2003, indicated the measured well depth was about 77 ft bgs. The injection well is housed in a below grade, circular vault about 3.5 ft bgs. The well casing extends approximately 24 in. above the bottom of the well vault. The bottom of the well vault consists of crushed gravel and is covered with an oily residue. The well vault construction resembles a dry well with a gravel base to allow for the discharge of liquid waste into the below grade soil. A 2-in. drain line enters the west side of the well vault at a depth of approximately 2 ft bgs (about 6-in. below the top of the injection well). The injection well and well vault are protected inside a circular, flat-roof steel shelter approximately 7 ft in diameter and about 3.5 ft in height. Access to the well is limited to a 6-in. square access port located in the center of the roof. The housing is painted yellow and an orange, high-visibility fence surrounds the steel housing. Available building drawings indicate the 2-in. drain line is connected to the three holding tanks and drains into the well vault/injection well structure. Two of the holding tanks (eastern and western) and the injection well are a radiological posted area (e.g., underground radioactive material). Figure 2-3 shows the site plan for CAS 03-20-05.

The blowout preventer and other equipment were used in drill-back operations for nuclear tests between 1980 and 1989. Based on historical records and interviews, the three holding tanks located within the building were used to hold cleaning and lubricating liquids used in the testing of the blowout preventer and drilling equipment. The blowout preventer and other equipment were cleaned within the holding tanks using a combination of various liquids (e.g., water, lubricating oil, solvents, and acids). The blowout preventer equipment was attached to the flange at the top of the sump and the internal parts of the equipment were cleaned using a pressurized wash of the cleaning solution and/or lubricating oil. Approximately twice a month excess liquid and residue (i.e., wastewater) was pumped from the holding tanks to the well vault/injection well adjacent to the demolished Lineman Building through the 2-in. drain line.

Documentation indicated the injection well became clogged with waste and subsequent discharge of wastewater was pumped through a hose to a concrete decontamination pad located west of the BOP Shop (IT, 2000). This discharge will be addressed as part of the CAU 145, CAS 03-20-08, investigation.

The facilities were deactivated and decommissioned in December 1989 and are currently inactive.

2.3 *Waste Inventory*

Interviews with former site employees, available documentation, facility process knowledge, interpretation of engineering drawings, and general historical NTS practices indicate industrial effluents and potential contaminants were discharged to the soil at the three CAS locations. Unknown volumes and concentrations of petroleum hydrocarbons, various chemical compounds, and/or radionuclides may have been released to surface, near-surface, and deep subsurface soil. Release information and previous sampling efforts, as summarized in Section 2.4 and Section 2.5,

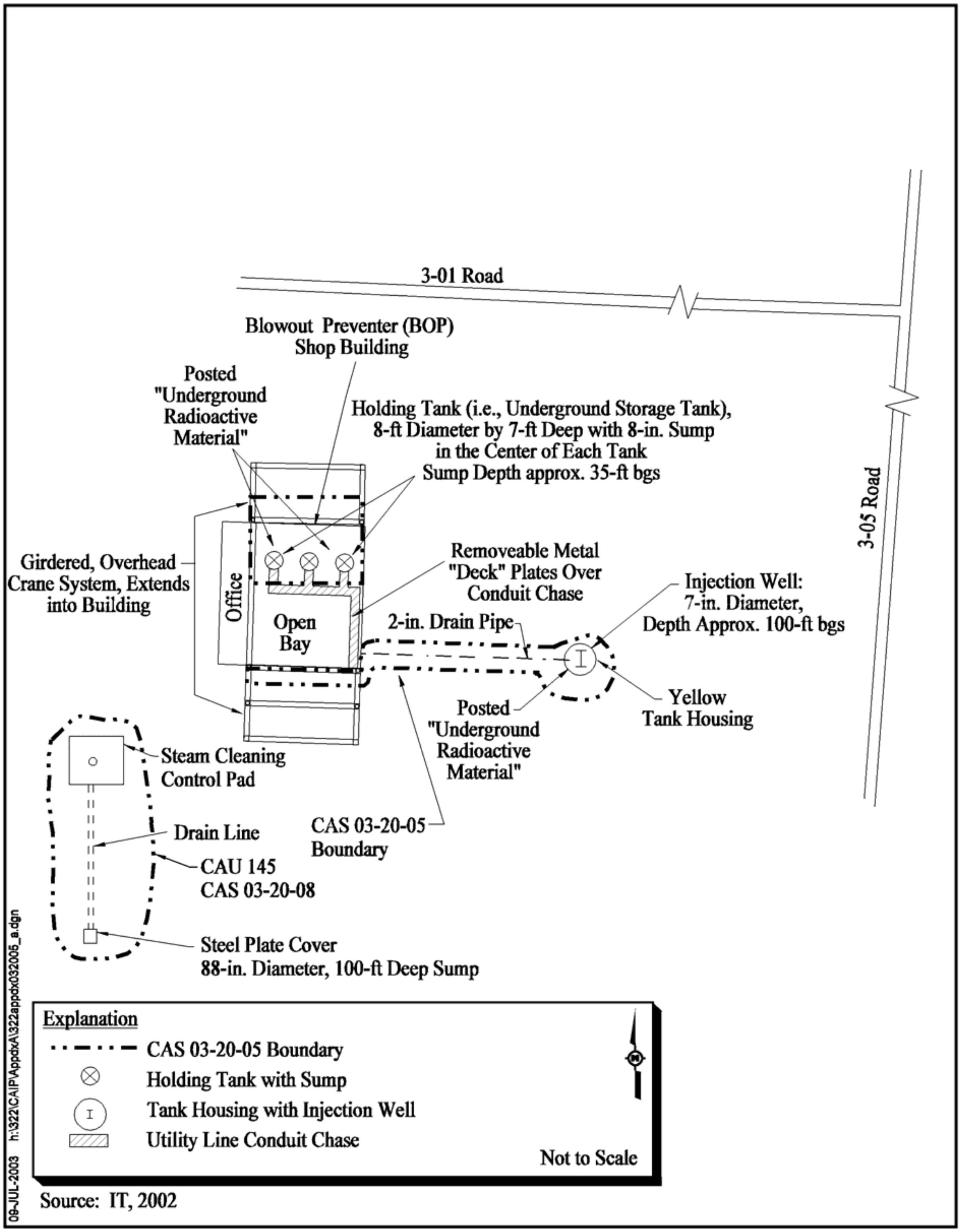


Figure 2-3
CAS 03-20-05, Site Plan of the Injection Wells

respectively, identified hazardous materials present in the media associated with each CAS of CAU 322, except for CAS 01-25-01.

These sources did not indicate that the CASs included in this CAU were, or were not, used to dispose of material considered to be hazardous waste as defined by current standards. There is sufficient process knowledge to indicate that radiological contaminants of potential concern (COPCs) were released and chemical COPCs may have been released to the environment. Available information was evaluated during the DQO process, and a list of potential contaminants was developed and is provided in Section 3.2.

No disposal records were identified during the preliminary assessment of this CAU; therefore, the specifics of the waste are dependent upon the sources of information previously mentioned. The types of waste suspected to be present in each of the parcels are summarized in the following sections.

2.4 Release Information

Primary sources of potential environmental contaminants released to the areas within each CAS and the surrounding area from past operations include:

- AST release
- Spill of diesel fuel during the refueling of water trucks at the Area 3 Mud Plant
- Liquid discharges of process water (i.e., the release of lubricating oil, solvents, and acids mixed with water during the cleaning of the blowout preventer equipment) via run-off across the building floor, from infiltration of wastewater beneath the injection well vault, and from discharge to the injection well

No other releases from adjacent areas or operations are known to have impacted these CASs.

2.4.1 CAS 01-25-01, AST Release

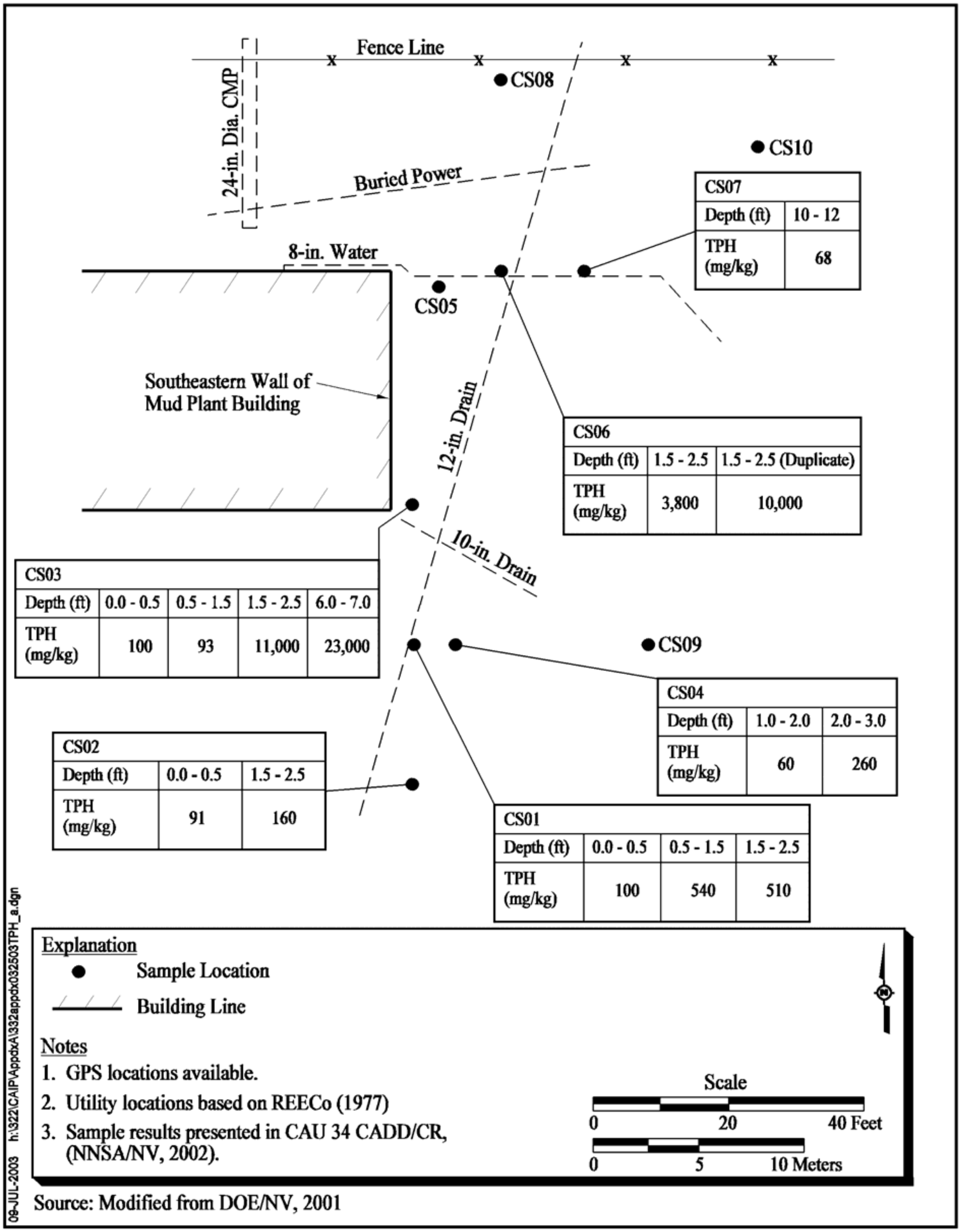
Sources of Potential Contamination - Historical records indicated a 10,000-gal AST was relocated from a gravel containment pit (CAS 01-25-01) to a nearby concrete containment pit. The existing AST has a capacity of 10,000 gal and is believed to be the relocated tank. The AST was used to store fuel oil (i.e., diesel) and service the Shaker Plant. No evidence of a spill (e.g., staining) was observed and available records did not contain information that indicated a release of fuel oil occurred at the CAS. Although there are no documented releases, unreported overfills and small spills may have released petroleum hydrocarbons to the soil within the CAS.

2.4.2 CAS 03-25-03, Mud Plant AST Diesel Release

Sources of Potential Contamination - CAS 03-25-03 consists of three petroleum hydrocarbon releases in two areas of the former Mud Plant at the Area 3 Camp. Two of the reported releases occurred in the western portion of the complex referred to as Area A for this investigation and shown on Figure 2-2. Available documents regarding the Mud Plant facility included information about a release of diesel fuel which occurred at a fuel dispensing station within Area A. The release occurred on February 20, 1992, during the unattended refueling of a service truck. Documentation indicated between 50 to 100 gal of diesel fuel was reported to have been spilled. The spill was reported to the Environmental Protection Division (EPD) on February 24, 1992, and assigned an EPD Case Number 92A03-15 (REECo, 1994). Cleanup activities included a limited excavation of surface soil contaminated with diesel fuel oil.

The second release of diesel fuel in Area A of CAS 03-25-03 was discovered during the cleanup of the initial fuel spill. Soil contaminated with fuel oil was observed as a result of a leaking buried valve on the fuel line connecting the AST and the fuel dispensing station. Approximately 8,100 cubic feet (ft^3) of soil was excavated as a result of the two diesel-fuel releases. The fuel-contaminated soil was subsequently disposed of in the U-10 crater (Stewart, 1992; and Madsen, 2000).

The third hydrocarbon contamination area within CAS 03-25-03 is located adjacent to the east wall of the Mud Plant building. The location of the contaminated soil is shown in Figure 2-2 (Area B). Contaminated soil was discovered when analytical results for CAU 34, CAS 03-44-02, were analyzed for petroleum hydrocarbons and results indicated total petroleum hydrocarbons (TPH) diesel-range organics (DRO) to be present at concentrations above the PAL of 100 milligrams per kilograms (mg/kg) (Figure 2-4). The contamination is believed to be the result of diesel generators that were stored and/or operated in the study area. Sources of the contamination might have been overfilling or spills of diesel fuel during operation and refueling of the generators. Another alternative source of the contamination may have been fuel oil originating in the area of the western AST (Area A fuel spill) that migrated downgradient following buried utility lines to the east end of the building.



CS07	
Depth (ft)	10 - 12
TPH (mg/kg)	68

CS06		
Depth (ft)	1.5 - 2.5	1.5 - 2.5 (Duplicate)
TPH (mg/kg)	3,800	10,000

CS03				
Depth (ft)	0.0 - 0.5	0.5 - 1.5	1.5 - 2.5	6.0 - 7.0
TPH (mg/kg)	100	93	11,000	23,000

CS04		
Depth (ft)	1.0 - 2.0	2.0 - 3.0
TPH (mg/kg)	60	260

CS02		
Depth (ft)	0.0 - 0.5	1.5 - 2.5
TPH (mg/kg)	91	160

CS01			
Depth (ft)	0.0 - 0.5	0.5 - 1.5	1.5 - 2.5
TPH (mg/kg)	100	540	510

Notes
1. GPS locations available.
2. Utility locations based on REECo (1977)
3. Sample results presented in CAU 34 CADD/CR, (NNSA/NV, 2002).

Source: Modified from DOE/NV, 2001

Figure 2-4
CAS 03-25-03, Summary of TPH Analytical Results for Soil Samples Collected During CAU 34, CAS 03-44-01 Investigation

2.4.3 CAS 03-20-05, Injection Wells

Sources of Potential Contamination - Information indicates that the wastewater in the BOP Shop holding tanks contained a solution of water, solvents, lubricating oils, oil and grease, and possibly radionuclides. The estimated monthly discharge from the tanks to the injection well was about 20 gals per month based on information from interviews with former employees (DOE, 1988). The configuration of the drain pipe and the infiltration well casing within the well vault appears to resemble an oil/water separator where a separate phase liquid would float on the surface of the wastewater and would drain into the injection well. Heavier solids would settle to the bottom of the well vault and liquid would infiltrate downward through the gravel bottom into the underlying soil. This discharge of wastewater into the well has potentially contaminated the subsurface soil and groundwater. Other potential sources of contamination include possible runoff of wastewater from the building floor to the soil along the front and rear of the BOP Shop, leakage of wastewater between the sump casing and the concrete floor, leakage from the sump casing, and a possible leak and/or disconnect along the buried 2-in. pipeline.

2.5 Investigative Background

Past investigation at these CASs included soil sampling for the gravel containment pit contents at CAS 01-25-01, soil sampling for petroleum hydrocarbon contamination at CAS 03-25-03, and liquid and sludge sampling of holding tanks contents and residue at the well vault/injection well at CAS 03-20-05. The following summarizes the results of this previous sampling at each CAS in CAU 322.

2.5.1 CAS 01-25-01, AST Release

Previous Investigation Results - An electromagnetic (EM) survey was performed using an EM-31 electromagnetic conductivity instrument. An anomaly was identified to extend from the southwest to the northeast through the center of the gravel pit. The EM response suggested the feature is not metallic, a very small diameter cable, or conduit-type feature. However, its position relative to the former AST location suggests the increased area of conductivity is attributed to a possible unreported fuel release. (Shaw, 2003)

A surface soil sample was collected in 2002 from within the northern portion of the gravel containment area and analyzed for volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), RCRA metals, and radionuclides. Acetone was detected at a concentration of 0.023 mg/kg, which is below the PAL. The PCB concentrations were below the detection level of 0.033 mg/kg except for Aroclor-1248 at a concentration of 0.064 mg/kg. The soil sample analyzed using gamma spectroscopy, gross alpha, and gross beta. The only man-made nuclide found was cesium (Cs)-137. Test results were reported to be within background levels. Results of the analyses for RCRA metals showed an arsenic concentration of 7.7 mg/kg, which exceeded the PAL of 2.7 mg/kg. Although the arsenic concentration exceeded the PAL, the reported level was considered representative of ambient conditions at the NTS. Concentrations of the remaining parameters were within background levels.

The critical COPCs identified for CAS 01-25-01 are TPH (DRO and gasoline-range organics [GRO]) based on available test results, process knowledge, interviews, and available records. The noncritical COPCs include VOCs, semivolatile organic compounds (SVOCs), and metals. Polychlorinated biphenyls are considered uncritical COPCs; detection of Aroclor-1248 was slightly above the detection limit and may not be an indicator of contaminants at the site.

2.5.2 CAS 03-25-03, Mud Plant AST Diesel Release

Previous Investigation Results - An EM survey was performed using an EM-31 and EM-61 electromagnetic conductivity instruments. The survey encompassed approximately 18,000 square feet (ft^2) centered over the area between the Mud Plant and the gravel bermed former AST area. Three linear anomalies were identified and interpreted to represent underground piping. However, their location does not appear to intersect the former AST location. (Shaw, 2003)

The two releases of diesel fuel at the AST and fuel dispensing station exceeded the State of Nevada action level of 10 ft^3 of soil containing greater than 100 mg/kg TPH and 25 gal of a petroleum product released. One soil sample was collected at the ground surface in the area of the fuel spill and had a TPH concentration of 34,600 mg/kg. Two soil samples were collected at a depth of 0.8 ft beneath the fuel spill area and had TPH concentrations below the method detection limit of 10 mg/kg.

During the cleanup and excavation of contaminated soil resulting from the fuel spill, a second area of contaminated soil was discovered in the area beneath a buried fuel line and valve. An interviewee reported contaminated soil was excavated to a depth of between 10 to 16 ft (the limit of the excavator) (Stewart, 1992). Two composite soil samples were collected from the sidewalls of the excavation and analyzed for TPH. The results were below the method detection limit. However, a bottom sample had a TPH concentration of 55,500 mg/kg. The location of the soil sample was not identified. In addition, the exact location of the excavation was not available.

The third reported area of contaminated soil within CAS 03-25-03 is located adjacent to the east side of Mud Plant facility. The TPH contamination was detected during the investigation of CAS 03-44-02, and analytical results indicated TPH (DRO) concentrations above the PAL of 100 mg/kg in 10 of 14 samples. The TPH concentrations in the soil ranged from 60 mg/kg (detected at a depth of 1 to 2 ft bgs) to 23,000 mg/kg (detected at a depth of 6 to 7 ft bgs). In addition, samples were analyzed for total chromium, toxicity characteristic leaching procedure (TCLP) chromium, VOCs, SVOCs, and RCRA metals. Results of the sampling are as follows:

- No VOCs were detected in soil samples at concentrations exceeding the PALs.
- No SVOCs were detected in soil samples at concentrations exceeding PALs.
- All the total metal results were below PALs, except for arsenic and chromium.

The arsenic levels are within the range reported to be naturally occurring within the area of NTS (McArthur and Miller, 1989). Chromium was detected at or above the PAL of 450 mg/kg in two soil samples (450 to 530 mg/kg) from CAS 03-44-02. Additional TCLP chromium analyses were performed for three samples. Results showed leachable chromium concentrations to be 0.12 milligrams per liter (mg/L), 0.59 mg/L, and 0.11 mg/L. These concentrations are below the regulatory requirements. The presence of chromium was addressed in the CAU 34 Corrective Action Decision Document/Closure Report (CADD/CR) and is not addressed in this investigation.

The critical COPCs identified for CAS 03-25-03 are TPH (DRO and GRO) based on available test results, interviews, process knowledge, and available records. The noncritical COPCs include VOCs, PCBs, SVOCs, radionuclides, and metals based upon process knowledge and general NTS concerns.

2.5.3 CAS 03-20-05, Injection Wells

Previous Investigation Results - A geophysical survey and an EM survey were completed near the location of the injection well and the eastern side of the BOP Shop. The geophysical survey was performed using ground-penetrating radar (GPR) equipment and the EM survey was performed using the EM-31 electromagnetic conductivity instrument. Three linear anomalies were identified in the surveyed area. The anomalies tend generally west to east. One of the anomalies appeared to originate in the southeast corner of the BOP Shop and traverse toward the injection well. The remaining two anomalies appeared to be located parallel to the injection well but north of the BOP Shop. (Shaw, 2003)

Preliminary sampling and analysis was conducted in 2001 on samples of liquid, soil, and sludge from the holding tanks and the well vault/injection well within this CAS. The analytical suite consisted of VOCs, SVOCs, TPH, and metals. Table 2-1 presents a summary of the analytical results. Radionuclide data was not available. The analytical results include the following:

- VOCs were detected in soil and liquid samples at concentrations exceeding the PALs.
- SVOCs were detected in liquid samples; however, concentrations were below their respective PALs.
- TPH was detected in soil and sludge samples at concentrations exceeding PALs.
- RCRA metal results were below PALs.

The critical COPCs identified for CAS 03-20-05 are based on prior test results, interviews, and process knowledge and include the following:

- TPH (DRO and GRO), hydraulic oil, and oil and grease from the servicing and decontamination of equipment
- VOCs: chlorobenzene, isopropylbenzene, n-propylbenzene; 1,2,4-trimethylbenzene; 1,2-dichlorobenzene; 1,3,5-trimethylbenzene; o-xylene; chloroform, choroethane; chloromethane
- SVOCs: 4-methylphenol; bis (2-ethylhexyl) phthalate; and naphthalene
- Radionuclides: Cs-137; strontium (Sr)-90; plutonium (Pu)-238, -239/240; americium (Am)-241; and uranium (U)-234, -235 from the posted radioactive warning signs as well as process knowledge for the decontamination of drilling equipment
- RCRA metals: Arsenic

Table 2-1
Analytical Results for Previous Sampling at CAU 322, CAS 03-20-05, Injection Wells

Sample ID	Location	Description of Location and Media	Contaminant	Result		Contaminant Class	PRG	
				Liquid (µg/L)	Soil (mg/kg)		Liquid (µg/L)	Soil (mg/kg)
3221C18	IW-1[a] (Dry well is not part of CAS 03-20-05)	Bottom of Sludge	1,2-Dichlorobenzene		1.8	VOC		370
			bis (2-Ethylhexyl) phthalate		21	SVOC		180
			Arsenic		**10**	Metals		2.7
			TPH		**2,913.80**	TPH		100
3222A13	IW-2	Cellar/Sump Soil (within CAS)	Chloroform		0.097	VOC		0.52
			bis (2-Ethylhexyl) phthalate		110	SVOC		180
			Arsenic		**57**	Metals		2.7
3222B14	IW-2	Top of Liquid	4-Methylphenol	**450**		SVOC	180	
3222C15	IW-2	Bottom of Liquid	4-Methylphenol	**460**		SVOC	180	
3223C21	IW-3	Bottom of Liquid	bis (2-Ethylhexyl) phthalate	**16**		SVOC	4.80	
3224A12	IW-4	Cellar/Sump Soil	Chloroform		0.49	VOC		0.52
			bis (2-Ethylhexyl) phthalate		150	SVOC		180
3224C09	IW-4	Bottom of Sludge	Chlorobenzene		12	VOC		540
			Isopropylbenzene		0.9	VOC		520
			Naphthalene		0.86	VOC		190
			n-propylbenzene		1.70	VOC		240
			1,2,4-Trimethylbenzene		12.0	VOC		170
			1,3,5-Trimethylbenzene		3.0	VOC		70
			o-Xylene		0.61	VOC		210
			bis (2-Ethylhexyl) phthalate		16	SVOC		180
			TPH		**24,411**	TPH		100
3224C11	IW-4	Bottom of Liquid	4-Methylphenol	**750**		SVOC	180	
3224B10	IW-4	Top of Liquid	4-Methylphenol	**740**		SVOC	180	
3225A19	IW-5	Cellar/Sump Soil	TPH		2230	TPH		100
322SSA03	Unknown	Soil	Chloroethane		1.1	VOC		4.6
			Chloromethane		0.12	VOC		1.5

Notes: Laboratory data provided by Bechtel Nevada.

[a] Well IW-1 is the injection well located at the steam-cleaning pad. This injection well is not part of CAS 03-20-05; however, contaminants found in IW-1 have the potential to be found elsewhere at the site. IW-2, IW-3, and IW-4 are the holding tanks in the LANL Post-Shot Yard, Building 03-3C-02. IW-5 correlates to the injection well located proximal to the Lineman Building.

IW = Injection well VOC = Volatile organic compounds SVOC = Semivolatile organic compounds TPH = Total petroleum hydrocarbons µg/L = Micrograms per liter
mg/kg = Milligrams per kilogram PRG = Preliminary remediation goals NA = Not applicable

- Polychlorinated biphenyls are common concerns at the NTS and have not been ruled out based upon process knowledge

Similarly, the noncritical COPCs identified below are based on interviews, common NTS concerns, and process knowledge:

- The remaining VOCs and SVOCs in the target compound list (TCL) and metals are representative of the constituents in the waste liquid and decontamination of drilling equipment.

2.5.4 National Environmental Policy Act

In accordance with the NNSA/NSO *National Environmental Policy Act* (NEPA) compliance program, a NEPA checklist will be completed prior to commencement of site investigation activities at CAU 322. This checklist compels NNSA/NSO project personnel to evaluate their proposed project activities against a list of potential impacts that include, but are not limited to: air quality, chemical use, waste generation, noise level, and land use. Completion of the checklist results in a determination of the appropriate level of NEPA documentation by the NNSA/NSO Compliance Officer.

3.0 Objectives

This section presents an overview of the DQOs for CAU 322 and formulation of the CSMs. Information on the COPC and PALs for the investigation are also presented.

3.1 Conceptual Site Models

The CSMs demonstrate the most probable scenario for current conditions at a site and define the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. Two CSMs have been developed for CAU 322 using assumptions formulated from the physical setting, knowledge from studies of similar sites, historical background information, potential contaminant sources/release information, and data from previous sampling efforts. The CSMs identify the possible release from, the failure of, or leaking from holding tanks, surface fuel spills and infiltration from a well vault (e.g., dry well), discharge from an injection well at the various CAS locations as the primary sources of VOCs, SVOCs, metals, TPH, PCBs, and radionuclides. Other unknown activities also may have released contaminants from previous activities at CAU 322 that could adversely impact the environment. Appendix A.1, Section A.1.1.3 provides more detailed information on the CSMs as presented for the DQO formulation. Table 3-1 identifies how the potential sources relate to the suspected contaminants identified in the CSMs for CAU 322.

If evidence of potential contamination outside the scope of the CSMs is identified during investigation activities, the situation will be reviewed and a recommendation will be made as to how best to proceed. In such cases, NDEP will be notified and given the opportunity to comment on and/or concur with the recommendation.

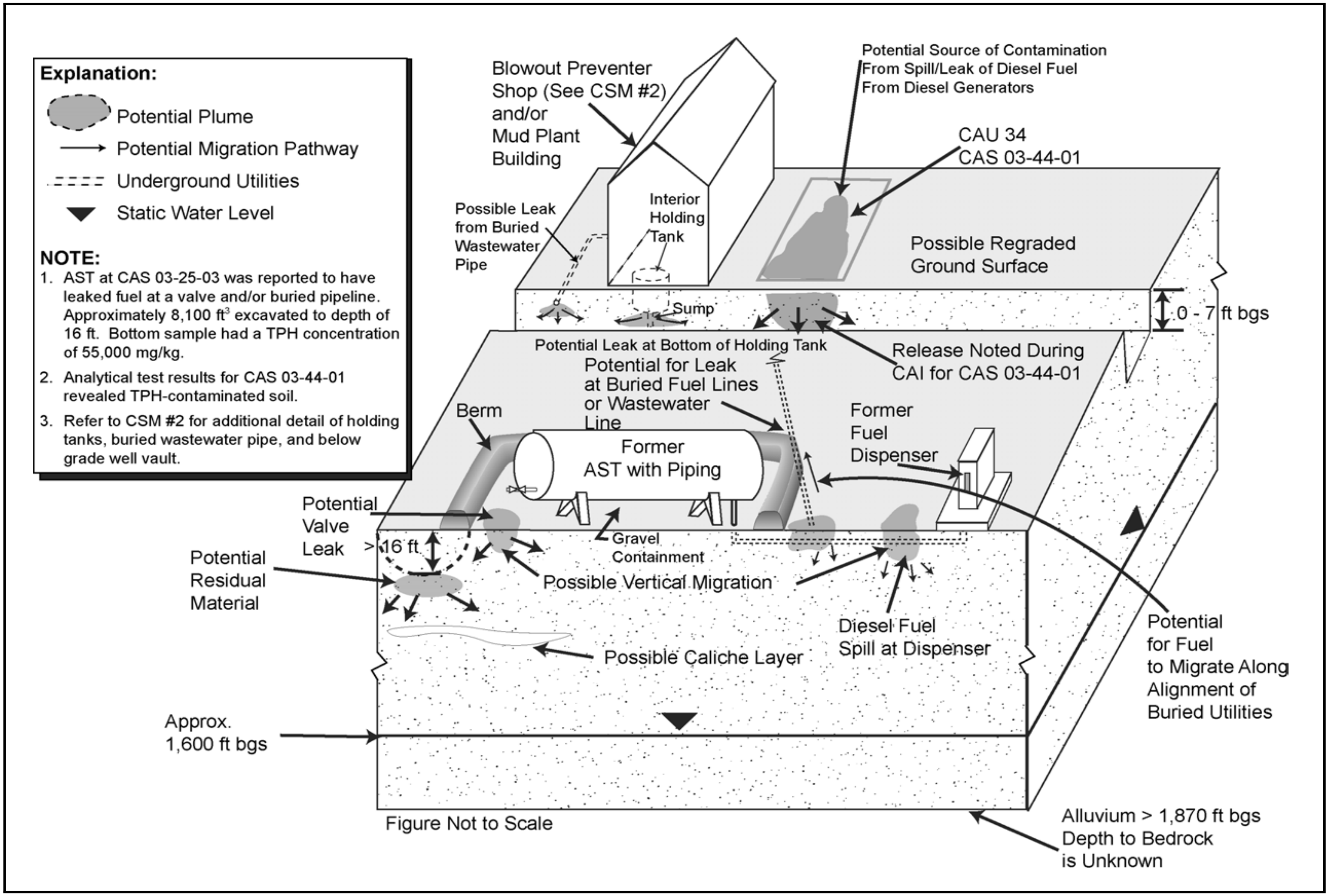
The two CSMs for CAU 322 are presented in Figure 3-1 and Figure 3-2. Each CSM developed for this investigation is presented below:

- Surface/Near-Surface - Figure 3-1 shows CSM #1 developed for the current site conditions at CASs 01-25-01 and 03-25-03, and represents the identified surface and potential pipeline disconnect or leak release mechanism. For illustrative purposes, the identified uncontrolled release of mechanism for the well vault, leakage from the bottom of the three below grade holding tanks, and potential for surface release at CAS 03-20-05 are presented on CSM #2.

Table 3-1
Conceptual Site Model, Potential Sources, and Chemicals of Potential Concern

Potential Sources for Conceptual Site Model	Chemicals of Potential Concern					
	Petroleum Hydrocarbons (TPH)	Volatile Organic Compounds (VOCs)	Semivolatile Organic Compounds (SVOCs)	Polychlorinated Biphenyls (PCBs)	Metals	Radionuclides
CAS 01-25-02, AST Diesel Release						
Failure or leaking from AST	X	X	X			
Other activities associated with the operation of the AST	X	X	X	X		
CAS 03-25-03, Mud Plant AST Diesel Release						
Failure or leaking from the AST	X	X	X			
Surface spill of diesel fuel	X	X	X	X		
Other activities associated with the operation of the Mud Plant	X	X	X	X	X	X
CAS 03-20-05, Injection Wells						
Discharge from the injection well	X	X	X	X	X	X
Infiltration from the dry well	X	X	X	X	X	X
Surface spill from cleaning activities	X	X	X	X	X	X
Leakage from holding tanks and sumps	X	X	X	X	X	X
Other activities associated with the operation of the BOP Shop	X	X	X	X	X	X

X = Analyses



NOTE:

1. AST at CAS 03-25-03 was reported to have leaked fuel at a valve and/or buried pipeline. Approximately 8,100 ft^3 excavated to depth of 16 ft. Bottom sample had a TPH concentration of 55,000 mg/kg.
2. Analytical test results for CAS 03-44-01 revealed TPH-contaminated soil.
3. Refer to CSM #2 for additional detail of holding tanks, buried wastewater pipe, and below grade well vault.

Figure 3-1
Surface/Near-Surface Conceptual Site Model #1 for CAU 322, CASs 03-25-03 and 01-25-01

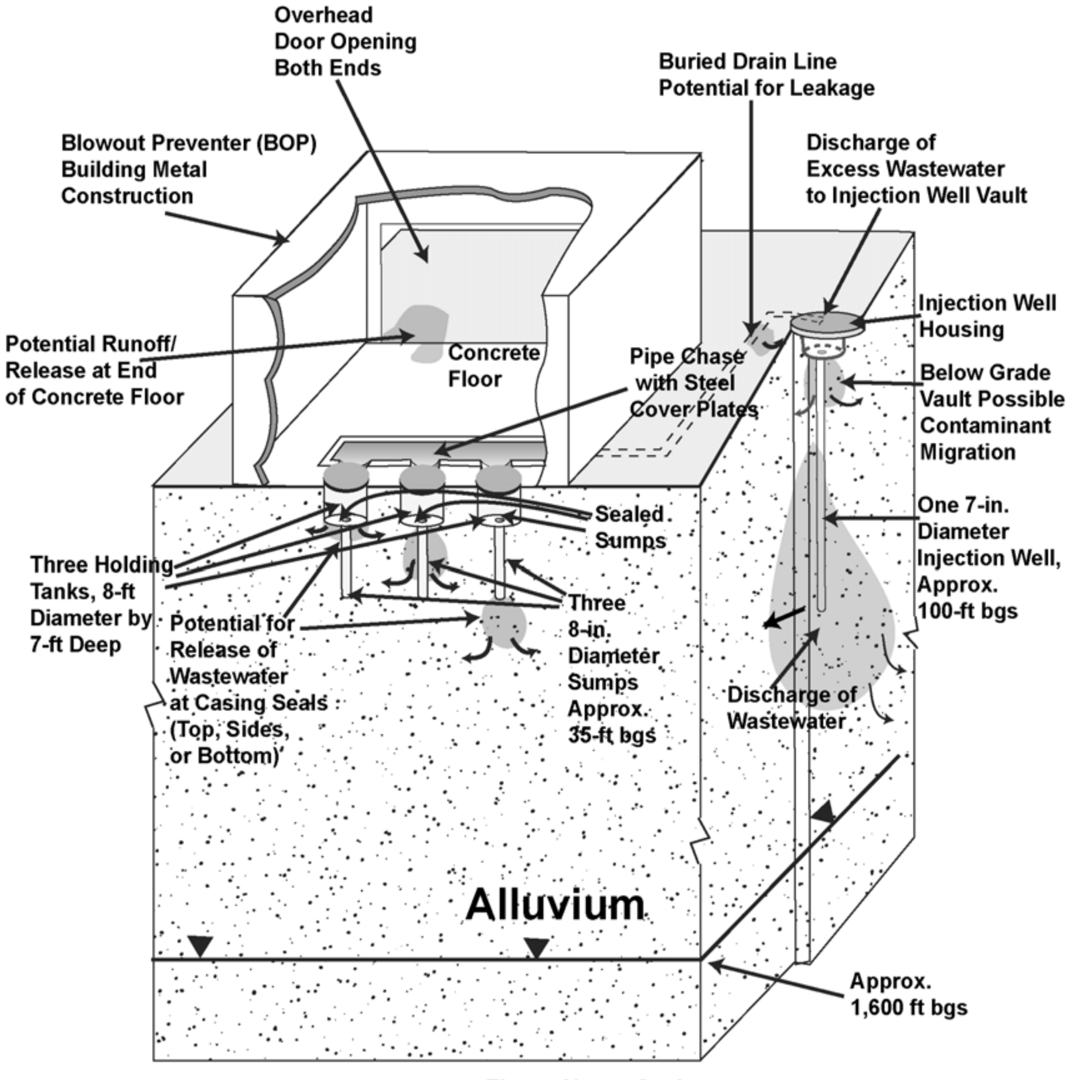


Figure Not to Scale

Explanation:

▨ Potential Plume
→ Potential Migration Pathway
= = = = Underground Pipe
▼ Static Water Level

NOTE:

1. Holding tanks and sumps are a closed system. Sump casing about 8-in. inside diameter and depth of 35 ft.
2. Casing flange of sump designed to support blowout preventor during cleaning.
3. Wastewater from the holding tanks pumped to the injection well through a 2-in. pipe.
4. Bedrock at depth of greater than 1,870 ft bgs based on boring log of USGS Well A located approximately 400 ft northeast of CAS.
5. Two of the holding tanks (i.e., center and east side) contained wastewater on date of site visit (Jan. 9, 2003.)
6. All three holding tanks were covered with steel plates.

☐ **Alluvium**

Figure 3-2
Deep Injection Conceptual Site Model #2 for CAU 322, CAS 03-20-05

- Deep Injection - Figure 3-2 shows CSM #2 developed for the current site conditions at CAS 03-20-05 and represents the uncontrolled release of chemical constituents to the deep subsurface from the injection well and the holding tank sumps.

Site-specific information is presented in Section 2.0. A discussion in Section A.1.1.3 also provides information on the CSMs.

3.1.1 Future Land Use

Future land-use scenarios for CAU 322 are research, test, and experiment. This area is designated for small-scale research and development projects and demonstrations; pilot projects; outdoor tests; and experiments for the development, quality assurance, or reliability of material and equipment under controlled conditions. This also includes compatible defense and nondefense research, development, and testing projects and activities. (DOE/NV, 1998)

3.1.2 Contaminant Sources and Release Mechanisms

Table 3-1 correlates the contaminant sources and release mechanisms to the various CSMs. The contaminant sources and release mechanisms are associated with the environmental releases described in Section 2.4.

Release of contamination would be attributed to direct release to the surface, release of contaminants through discharge to a dry well or injection well, leakage of underground piping, potential migration along underground utility trenches, and erosion of various contaminants off the surface of solid materials.

3.1.3 Migration Pathways

Two preferential pathways for potential contaminant migration have been identified. Lateral migration of potential contaminants across surface soils/sediments and typical vertical migrations due to gravity through subsurface soils. Grading or sloping at sites may cause a lateral migration prior to the vertical immigration. Contamination, if present, is expected to be contiguous to the source and is expected to decrease with distance and depth from a release point. Contaminants may be transported by infiltration of precipitation, which serves as a driving force for downward migration of contaminants. However, the average annual precipitation on the valleys of the NTS range from about

3 to 10 in. The potential annual evaporation from lake and reservoir surfaces was estimated to range between 60- and 82-in. per year, or roughly 5 to 25 times the annual precipitation (Winograd and Thordarson, 1975).

In the case of a release from a dry well or injection well, the migration pathway for contaminant release would be primarily vertical due to infiltration, precipitation, and volume of the waste during disposal. It is assumed that groundwater may be affected by the waste. Historical research and nearby Well A show that there is groundwater in the vicinity of CAS 03-20-05 at an expected depth of 1,600 ft bgs (USGS, 2002).

An important element of the CSM in developing a sampling strategy is the expected fate and transport of contaminants, which infer how contaminants migrate through media and where they can be expected in the environment. Fate and transport of contaminants are presented in the CSM as the migration pathways and transport mechanism that could potentially move the contaminants throughout the various media. Fate and transport are influenced by physical and chemical characteristics of the contaminants and media. Contaminant characteristics include, but are not limited to: solubility, density, and adsorption potential. Media characteristics include permeability, porosity, water saturation, sorting, chemical composition, and organic content. In general, contaminants with low solubility, high affinity for media, and high density can be expected to be found relatively close to release points. Contaminants with high solubility, low affinity for media, and low density can be expected to be found further from release points. These factors affect the migration pathways and potential exposure points for the contaminants in the various media under consideration.

3.1.4 Exposure Points

The exposure points for potential site receptors (i.e., military personnel, industrial workers, and construction workers) are primarily contaminated surface soils throughout the CAS. Exposure to subsurface materials would result from excavation activities or through erosion of subsurface materials that were subsequently deposited on the surface.

Exposure points within the CASs are the locations where visitors, site workers, or military personnel will come in contact with potential contaminants within the CAS boundaries. The exposure points at

CASs 01-25-01 and 03-25-03, and for portions of CAS 03-20-05, would be the surface and shallow subsurface at locations where contamination is present (e.g., chemically contaminated concrete and soil).

3.1.5 Exposure Routes

Exposure routes to visitors, site workers, or military personnel include ingestion, inhalation, and/or dermal contact (absorption) from disturbance of contaminated soils, debris, and/or structures. Site workers may also be exposed to radiation by performing activities in proximity to radiologically contaminated materials.

3.1.6 Additional Information

General surface and subsurface soil descriptions will be observed and recorded during the CAI.

Climatic conditions for the CAU are well documented for this area of the NTS and were addressed during the DQO process and reflected in the CSM. No further information is required.

Groundwater data for the CAU is known and has been addressed in the CSM. The CAS-specific depth to groundwater data are presented in Section 2.1. No further information is required.

Existing floodplain studies are available and will be considered during the corrective action, as necessary. No further information is required.

Specific structure descriptions will be observed and recorded during the CAI. The structures include the BOP Shop at CAS 03-20-05; the former Mud Plant building and associated structures, and former drilling mud pit in CAS 03-25-03; and various utilities.

No buildings or structures will be evaluated during the investigation. However, a utility survey will be conducted over portions of CASs to avoid underground utilities and to maintain a safe work environment.

3.2 Contaminants of Potential Concern

Suspected contaminants for CAU 322 were identified through a review of site history documentation, process knowledge, personal interviews, past investigation efforts, site-specific analytical data, analytical data from nearby CASs, and inferred activities associated with the CASs. The types of contamination suspected to be present at CAU 322 include TPH-DRO, TPH-GRO, SVOCs, VOCs, PCBs, and metals. The Phase I (Decision 1) CAS-specific COPCs are identified in Table 3-2. Contaminants of potential concern are defined as the analytes detected using the analytical methods listed in Table 3-3 for which the U.S. Environmental Protection Agency (EPA) Region IX has established preliminary remediation goals (PRGs) (EPA, 2002b) or for which toxicity data are listed in the EPA Integrated Risk Information System (IRIS) database (EPA, 2002a). Radiological COPCs are defined as the radionuclides reported from the analytical methods also listed in Table 3-3.

Table 3-2 identifies the critical COPCs identified for each CAS in CAU 322. Critical COPCs for Phase I samples are the potential chemical constituents that are reasonably suspected to be present at the site based on documented use, analytical results, or process knowledge. The critical COPCs are given greater importance in the decision-making process relative to noncritical COPCs and have a completeness goal of 90 percent. For this reason, more stringent performance criteria are specified for critical analyte DQIs and are discussed in Section 6.0.

Each COPC that is detected in a sample at concentrations exceeding the corresponding PAL becomes a COC for subsequent sampling (Phase II) to define the extent of contamination. These follow-up samples will be collected and analyzed only for the COCs determined by Decision I sampling. However, if extent samples are collected prior to nature-of-contamination data becoming available, the extent samples will be analyzed for the full list parameters given for each CAS in Table 3-2.

For CAU 322, source characterization is the focus of the sampling and analysis. The radiological analyses parameters have been included in the analytical suite to support the disposal of IDW and potential waste management decisions and to identify potential impacts from atmospheric testing.

Table 3-2
Phase I Analytical Program with COPCs and Critical Analytes for CAU 322

CAS 01-25-01		CAS 03-25-03 AST		CAS 03-20-05	
Chemical					
COPC	**Critical Analytes**	**COPC**	**Critical Analytes**	**COPC**	**Critical Analytes**
VOCs	None	VOCs	None	VOCs	Chlorobenzene, Isopropylbenzene, n-propylbenzene; 1,2,4-Trimethylbenzene; 1,2-Dichlorobenzene; 1,3,5-Trimethylbenzene; o-xylene;Chloroform; Choroethane; Chloromethane
SVOCs	None	SVOCs	None	SVOCs	Bis(2-ethylhexyl)phthalate; 4-Methylphenol; Napthalene
PCBs	None	PCBs	None	PCBs	Aroclor - 1016 Aroclor - 1221 Aroclor - 1232 Aroclor - 1242 Aroclor - 1248 Aroclor - 1254 Aroclor - 1260
TPH (C_6 - C_{38})	GRO	TPH (C_6 - C_{38})	GRO	TPH (C_6 - C_{38})	GRO
	DRO		DRO		DRO
RCRA Metals	None	RCRA Metals	None	RCRA Metals	Arsenic
Beryllium	--	Beryllium	--	Beryllium	--
Radionuclides					
None	None	Gamma Spectroscopy	None	Gamma Spectroscopy	Cs-137, Am-241, Co-60
None	None	Gross Beta	None	Gross Beta	Sr-90
None	None	Gross Alpha	None	Gross Alpha	Pu-238 and 239/240
None	None	Gross Alpha	None	Gross Alpha	U-234, -235, -238
None	None	None	None	Liquid Scintillation	Tritium

COPC = Contaminant of potential concern
CAU = Corrective Action Unit
DRO = Diesel-range organics
GRO = Gasoline-range organics
PCB = Polychlorinated biphenyls
TPH = Total petroleum hydrocarbons
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds
Cs = Cesium
Am = Americium
Sr = Strontium
Pu = Plutonium
U = Uranium
RCRA = *Resource Conservation and Recovery Act*

Table 3-3
Chemicals of Potential Concern and Analytical Requirements for CAU 322
(Page 1 of 3)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
ORGANICS						
Total Volatile Organic Compounds (VOCs)	Aqueous	8260B[c]	Parameter-specific estimated quantitation limits[d]	Not applicable (NA)	Lab-specific[e]	Lab-specific[e]
	Soil					
Toxicity Characteristic Leaching Procedure (TCLP) VOCs						
Benzene	Aqueous	1311/8260B[c]	0.050 mg/L[d]	0.5 mg/L[f]	Lab-specific[e]	Lab-specific[e]
Carbon Tetrachloride			0.050 mg/L[d]	0.5 mg/L[f]		
Chlorobenzene			0.050 mg/L[d]	100 mg/L[f]		
Chloroform			0.050 mg/L[d]	6 mg/L[f]		
1,2-Dichloroethane			0.050 mg/L[d]	0.5 mg/L[f]		
1,1-Dichloroethene			0.050 mg/L[d]	0.7 mg/L[f]		
Methyl Ethyl Ketone			0.050 mg/L[d]	200 mg/L[f]		
Tetrachloroethene			0.050 mg/L[d]	0.7 mg/L[f]		
Trichloroethene			0.050 mg/L[d]	0.5 mg/L[f]		
Vinyl chloride			0.050 mg/L[d]	0.2 mg/L[f]		
Total Semivolatile Organic Compounds (SVOCs)	Aqueous	8270C[c]	Parameter-specific estimated quantitation limits[d]	NA	Lab-specific[e]	Lab-specific[e]
	Soil					
TCLP SVOCs						
o-Cresol	Aqueous	1311/8270C[c]	0.10 mg/L[d]	200 mg/L[f]	Lab-specific[e]	Lab-specific[e]
m-Cresol			0.10 mg/L[d]	200 mg/L[f]		
p-Cresol			0.10 mg/L[d]	200 mg/L[f]		
Cresol (total)			0.30 mg/L[d]	200 mg/L[f]		
1,4-Dichlorobenzene			0.10 mg/L[d]	7.5 mg/L[f]		
2,4-Dinitrotoluene			0.10 mg/L[d]	0.13 mg/L[f]		
Hexachlorobenzene			0.10 mg/L[d]	0.13 mg/L[f]		
Hexachlorobutadiene			0.10 mg/L[d]	0.5 mg/L[f]		
Hexachloroethane			0.10 mg/L[d]	3 mg/L[f]		
Nitrobenzene			0.10 mg/L[d]	2 mg/L[f]		
Pentachlorophenol			0.50 mg/L[d]	100 mg/L[f]		
Pyridine			0.10 mg/L[d]	5 mg/L[f]		
2,4,5-Trichlorophenol			0.10 mg/L[d]	400 mg/L[f]		
2,4,6-Trichlorophenol			0.10 mg/L[d]	2 mg/L[f]		

Table 3-3
Chemicals of Potential Concern and Analytical Requirements for CAU 322
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Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
Polychlorinated Biphenyls (PCBs)	Aqueous	8082[c]	Parameter-specific (CRQL)[g]	NA	Lab-specific[e]	Lab-specific[e]
	Soil					
Total Petroleum Hydrocarbons (TPH) (C_6 - C_{38})	Aqueous-GRO	8015B modified[c]	0.1 mg/L[h]	NA	Lab-specific[e]	Lab-specific[e]
	Soil-GRO		0.5 mg/kg[h]			
	Aqueous-DRO		0.5 mg/L[h]			
	Soil-DRO		25 mg/kg[h]			
INORGANICS						
Total Metals						
Arsenic	Aqueous	6010B[c]	10 µg/L[h, i]	NA	20[i]	Matrix Spike Recovery 75-125[i] Laboratory Control Sample Recovery 80 - 120[i]
	Soil		1 mg/kg[h, i]		35[i,o]	
Barium	Aqueous	6010B[c]	200 µg/L[h, i]		20[i]	
	Soil		20 mg/kg[h, i]		35[i,o]	
Beryllium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil		0.5 mg/kg[h, i]		35[i,o]	
Cadmium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil		0.5 mg/kg[h, i]		35[i,o]	
Chromium	Aqueous	6010B[c]	10 µg/L[h, i]		20[i]	
	Soil		1 mg/kg[h, i]		35[i,o]	
Lead	Aqueous	6010B[c]	3 µg/L[h, i]		20[i]	
	Soil		0.3 mg/kg[h, i]		35[i,o]	
Mercury	Aqueous	7470A[c]	0.2 µg/L[h, i]		20[i]	
	Soil	7471A[c]	0.1 mg/kg[h, i]		35[i,o]	
Selenium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil		0.5 mg/kg[h, i]		35[i,o]	
Silver	Aqueous	6010B[c]	10 µg/L[h, i]		20[i]	
	Soil		1 mg/kg[h, i]		35[i,o]	
TCLP RCRA Metals						
Arsenic	Aqueous	1311/6010B[c] 1311/7470A[c]	0.10 mg/L[h, i]	5 mg/L[f]	20[i]	Matrix Spike Recovery 75-125[i] Laboratory Control Sample Recovery 80 - 120[i]
Barium			2 mg/L[h, i]	100 mg/L[f]		
Cadmium			0.05 mg/L[h, i]	1 mg/L[f]		
Chromium			0.10 mg/L[h, i]	5 mg/L[f]		
Lead			0.03 mg/L[h, i]	5 mg/L[f]		
Mercury			0.002 mg/L[h, i]	0.2 mg/L[f]		
Selenium			0.05 mg/L[h, i]	1 mg/L[f]		
Silver			0.10 mg/L[h, i]	5 mg/L[f]		

Table 3-3
Chemicals of Potential Concern and Analytical Requirements for CAU 322
(Page 3 of 3)

Parameter/Analyte	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
RADIOCHEMISTRY						
Gamma-Emitting Radionuclides	Aqueous	EPA 901.1[j]	The Minimum Reporting Limits and Minimum Detectable Activities for Radionuclides are given in Table 3-4	NA	Relative Percent Difference (RPD[a]) 20% (Water)[h] 35% (Soil)[h] Normalized Difference (ND) -2<ND<2[k]	Laboratory Control Sample Recovery 80-120[i]
	Soil	HASL-300[l]				
Isotopic Uranium	Aqueous	HASL-300[l] ASTM D3972-02[m]		NA		Chemical Yield 30-105[n] Laboratory Control Sample Recovery 80-120[i]
	Soil	HASL-300[l] ASTM C1000-00[m]				
Isotopic Plutonium	Aqueous	D3865-02[m] ASTM HASL-300[l]		NA		
	Soil					
Strontium - 90	Aqueous	ASTM D5811-00[m]		NA		
	Soil	HASL-300[l]				

[a] Relative percent difference (RPD) is used to calculate precision.
Precision is estimated from the relative percent difference of the concentrations measured for the matrix spike and matrix spike duplicate or of laboratory, or field duplicates of unspiked samples. It is calculated by: $RPD = 100 \times \{(|C_1-C_2|)/[(C_1+C_2)/2]\}$, where C_1 = Concentration of the parameter in the first sample aliquot,
C_2 = Concentration of the parameter in the second sample aliquot.

[b] %R is used to calculate accuracy.
Accuracy is assessed from the recovery of parameters spiked into a blank or sample matrix of interest, or from the recovery of surrogate compounds spiked into each sample. The recovery of each spiked parameter is calculated by: percent recovery $(\%R) = 100 \times (C_s-C_u/C_n)$, where C_s = Concentration of the parameter in the spiked sample,
C_u = Concentration of the parameter in the unspiked sample, C_n = Concentration increase that should result from spiking the sample

[c] U.S. Environmental Protection Agency (EPA) *Test Methods for Evaluating Solid Waste*, 3rd Edition, Parts 1-4, SW-846 CD ROM, Washington, DC (EPA,1996)

[d] Estimated Quantitation Limit as given in SW-846 (EPA, 1996)

[e] In-House Generated RPD and %R Performance Criteria
It is necessary for laboratories to develop in-house performance criteria and compare them to those in the methods. The laboratory begins by analyzing 15 to 20 samples of each matrix and calculating the mean %R for each parameter. The standard deviation (SD) of each %R is then calculated, and the warning and control limits for each parameter are established at ± 2 SD and ± 3 SD from the mean, respectively. If the warning limit is exceeded during the analysis of any sample delivery group (SDG), the laboratory institutes corrective action to bring the analytical system back into control. If the control limit is exceeded, the sample results for that SDG are considered unacceptable. These limits are reviewed after every quarter and are updated when necessary. The laboratory tracks trends in both performance and control limits by the use of control charts. The laboratory's compliance with these requirements is confirmed as part of an annual laboratory audit. Similar procedures are followed in order to generate acceptance criteria for precision measurements.

[f] Title 40 *Code of Federal Regulations* Part 261, "Identification and Listing of Hazardous Waste" (CFR, 2001a)

[g] EPA *Contract Laboratory Program Statement of Work for Organic Analysis* (EPA, 1988b; 1991; and 1994c)

[h] *Industrial Sites Quality Assurance Project Plan* (NNSA/NV, 2002a)

[i] EPA *Contract Laboratory Program Statement of Work for Inorganic Analysis* (EPA, 1988a; 1994b; and 1995)

[j] *Prescribed Procedures for Measurements of Radioactivity in Drinking Water*, EPA-600/4-80-032 (EPA, 1980)

[k] Normalized Difference is not RPD, it is another measure of precision used to evaluate duplicate analyses. The normalized difference is calculated as the difference between two results divided by the square root of the sum of the squares of their total propagated uncertainties. *Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997)

[l] *Manual of Environmental Measurements Laboratory Procedures*, HASL-300 (DOE, 1997)

[m] American Society for Testing and Materials

[n] *General Radiochemistry and Routine Analytical Services Protocol (GRASP)* (EG&G Rocky Flats, 1991)

[o] EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA540/R-94/013, February 1994 (EPA, 1994a)

Definitions:
mg/L = Milligrams per liter
mg/kg = Milligrams per kilogram
µg/L = Micrograms per liter
CRQL = Contract-required quantitation limits

3.3 Preliminary Action Levels

Laboratory analytical results for soil samples will be compared to the following PALs to evaluate the presence of COCs:

- EPA Region IX Preliminary Remediation Goals for Industrial Soils (EPA, 2002b). The population parameter for Phase I chemical data is the maximum observed concentration of each COC within the target population.
- Background concentrations for RCRA metals will be used instead of PRGs when natural background exceeds the PRG, as is often the case with arsenic. Background is considered the mean plus two times the standard deviation of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999).
- The TPH action level of 100 mg/kg per the NAC 445A.2272 (NAC, 2002e).
- For detected chemical COPCs without established PRGs, a similar protocol to that used by EPA Region IX will be used in establishing action levels for those COPCs listed in IRIS (EPA, 2002a).
- The PALs for radiological contaminants are isotope-specific and are defined as the maximum concentration for each isotope found in environmental samples taken from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991). The US Ecology and Atlan-Tech reference is used because soil samples have not been collected from undisturbed background locations of the NTS and analyzed for their radionuclide concentrations. Therefore, data is needed on the concentration of radionuclides in soil at undisturbed background locations located in the vicinity of the NTS. Based upon the Ward Valley climatography, geology, and radionuclide concentration data, the use of *Environmental Monitoring Report for the Proposed Ward Valley, California, Low-Level Radioactive Waste (LLRW) Facility* (US Ecology and Atlan-Tech, 1991) is appropriate for use in defining PAL concentrations based on background. The PALs are expressed in units of pCi/g for solid media or picocuries per liter (pCi/L) and are provided in Table 3-4.
- Solid media such as concrete may pose a potential radiological exposure risk to site workers if contaminated. The radiological PAL for solid media will be defined as the unrestricted-release criteria defined in the *NV/YMP Radiological Control Manual* (DOE/NV, 2000d).

The comparison of laboratory results to PALs will be discussed in the CADD. While laboratory results above action levels indicate the presence of COCs at levels that may require corrective action, these are not necessarily the final cleanup criteria.

Table 3-4
Requirements for Radionuclides in Solid Samples Collected at CAU 322

Radionuclide	Matrix	Analytical Method	MDC[a]	PAL[b]	Laboratory Precision	Percent Recovery
Gamma Spectrometry					Relative Percent Difference (RPD) 20% Water 35% Soil Normalized Difference (ND) -2<ND<2[e]	Laboratory Control Sample Recovery 80-120[f] Percent Recovery (%R) Chemical Yield 30-105[g]%R
Americium-241 (by Gamma Spectroscopy)	soil	HASL-300[d]	2.0 pCi/g[c]	2.0 pCi/g		
Niobium-94	soil	HASL-300[d]	0.5 pCi/g[c]	0.5 pCi/g		
Cesium-137	soil	HASL-300[d]	0.5 pCi/g	7.0 pCi/g		
Europium-152	soil	HASL-300[d]	4.0 pCi/g[c]	4.0 pCi/g		
Europium-154	soil	HASL-300[d]	2.5 pCi/g	2.5 pCi/g		
Europium-155	soil	HASL-300[d]	1.0 pCi/g[c]	1.35 pCi/g		
Cobalt-60	soil	HASL-300[d]	0.5 pCi/g[c]	0.5 pCi/g		
Tritium	soil	Method 754/704[h]	1.0 pCi/g	1.0 pCi/g		
Other Radionuclides						
Uranium-234	soil	HASL-300[d]	0.05 pCi/g	3.47 pCi/g		
Uranium-235	soil	HASL-300[d]	0.05 pCi/g	0.07 pCi/g		
Uranium-238	soil	HASL-300[d]	0.05 pCi/g	3.47 pCi/g		
Plutonium-238	soil	HASL-300[d]	0.05 pCi/g	0.05 pCi/g		
Plutonium-239/240	soil	HASL-300[d]	0.05 pCi/g	0.106 pCi/g		
Strontium-90	soil	HASL-300[d]	0.5 pCi/g	1.17 pCi/g		

[a] MDC is the minimum detectable concentration. It is the lowest concentration of a radionuclide, if present in a sample, that can be detected with a 95 percent confidence level.

[b] PAL is the preliminary action level and is defined as the maximum concentration listed in the literature for a sample taken from an undisturbed background location (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991; and DOE/NV, 1999). The PAL is equal to the MDA for isotopes not reported in soil samples from undisturbed background locations or if the PAL is less than the MDC.

[c] MDCs vary depending on the presence of other gamma-emitting radionuclides in the sample.

[d] *Environmental Measurements Laboratory Procedures Manual*, HASL-300 (DOE, 1997)

[e] Normalized Difference (ND) is not RPD, it is another measure of precision used to evaluate duplicate analyses. The ND is calculated as the difference between two results divided by the square root of the sum of the squares of their total propagated uncertainties. *Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997)

[f] EPA *Contract Laboratory Program Statement of Work for Inorganic Analysis* (EPA, 1988a; 1994b; and 1995)

[g] *General Radiochemistry and Routine Analytical Services Protocol (GRASP)* (EG&G Rocky Flats, 1991). The chemical yield only applies to uranium and strontium.

[h] Based on Paragon Analytics, Inc. Method 754/704 (PAI, 1999)

Definitions:
pCi/g = Picocuries per gram
pCi/L = Picocuries per liter

The population parameter for Phase II will be the observed concentration of each unbounded chemical and radiological COC in any sample. The evaluation of potential corrective actions and the justification for a preferred action will be included in the CADD based on the results of this field investigation. Proposed cleanup levels will be presented in the CADD.

3.3.1 Field-Screening Levels

Field screening may be instituted to provide semiquantitative measurements. The field-screening results (FSRs), along with other biasing factors, may help guide the selection of the most appropriate sampling location for collection of laboratory samples. The following action levels may be used for on-site field screening:

- TPH FSRs greater than 75 parts per million (ppm) measured using an appropriate field-screening method (e.g., a field gas chromatograph or an equivalent method).
- The radiological (alpha and beta/gamma) field-screening level (FSL) for soil samples is the mean background activity plus two times the standard deviation of the mean background activity.

Field-screening concentrations exceeding FSLs for radionuclides indicate potential contamination at that sample location. This information will be documented and the investigation will be continued in order to delineate the extent of contamination. Additionally, this data may also be used to select samples to be submitted for laboratory analysis.

3.4 DQO Process Discussion

The DQOs are qualitative, semiquantitative, and quantitative statements that define the type, quantity, and quality of data required to support evaluations of potential closure alternatives for CAU 322. The DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and to design a data collection program that will satisfy these purposes.

Details of the DQO process are presented in Appendix A.1. During the DQO discussion for this CAU, the informational inputs or data needs to resolve problem statements and decision statements were documented. Criteria for data collection activities were assigned. The analytical methods and reporting limits prescribed through the DQO process, as well as the DQIs for laboratory analysis such as precision and accuracy requirements, are provided in more detail in Section 6.0. Laboratory data will be assessed to confirm or refute each conceptual model and determine if the DQOs were met based on the DQIs of precision, accuracy, representativeness, completeness, and comparability. Other DQIs, such as sensitivity, may also be used.

The DQO strategy for CAU 322 was developed at a meeting held on January 28, 2003. The DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and to design a data collection program that will satisfy these purposes. During the DQO discussions for this CAU, the informational inputs or data needs to resolve the problem statement and decision statements were documented.

The problem statement for the investigation is, "There is an insufficient amount of information to characterize the nature and extent of contamination potentially released to surrounding areas to determine if there is a risk to human health and the environment." To address this problem, resolution of two decision statements is required:

- Decision I is, "Determine if a COC is present" by identifying any contamination above the PALs. Sample data must be collected in areas most likely to contain a COC and the analytical suite selected must be sufficient to detect any COCs present in the samples. If PALs are not exceeded, then the investigation is complete. If PALs are exceeded, then Decision II must be resolved.

- Decision II is, "Determine the lateral and vertical extent of a COC." Sample data must be collected and analyzed at locations to bound the lateral and vertical extent of COCs. The data required to satisfy the information needed for each COC is a sample result that is below the PAL.

The MDCs and PALs for radionuclides are provided in Table 3-4. The MDC is the lowest concentration of a particular parameter that can be detected in a sample at the 95 percent confidence level. The MDCs listed in Table 3-4 are typical default levels available for a commercial radioanalytical laboratory. The MDCs will be used as minimum reporting limits (MRLs) where isotope-specific PALs are not available.

4.0 Field Investigation

This section of the CAIP contains the approach for investigating CAU 322.

4.1 Technical Approach

The technical approach for CAU 322 consists of activities to be conducted prior to and during the CAI. This technical approach consists of, but is not limited to, the following activities:

- Conduct the necessary radiological surveys at CASs 03-25-03 and 03-20-05 to ensure worker health and safety.
- Collect and analyze samples from biased locations as described in this section.
- Collect required QC samples.
- Collect additional samples, as necessary, to estimate potential corrective action waste streams.
- Collect samples from native soils and analyze for geotechnical/hydrologic parameters, if necessary.
- Stake or flag sample locations and record coordinates (in North American Datum 1927 coordinate system).

4.2 Field Activities

This section provides a description of the field activities for all CASs at CAU 322. Process knowledge indicates TPH, VOCs, and SVOCs are present above PALs at CASs 03-25-03 and 03-20-05. If other contamination is identified, it is expected to be found within the spatial boundaries of the sites as defined in the DQO process and the CSMs. If while defining the nature of contamination, the investigation determines that COCs are present, the CASs will be further addressed by determining the lateral and vertical extent of contamination before evaluating corrective action alternatives. Only unbounded COCs (i.e., those outside of the spatial boundaries) will be considered during Phase II sampling.

Modifications to the investigative strategy may be required should unexpected field conditions be encountered. Significant modifications will be justified in a Record of Technical Change (ROTC).

An approved ROTC (i.e., concurrence from NNSA/NSO and NDEP) is required prior to proceeding with investigation activities significantly different from those described in this document. If contamination is more extensive than anticipated (e.g., the maximum investigation depth is limited by the capabilities of the equipment used to collect subsurface soil samples), the investigation will be rescoped. The investigation will also be rescoped if the CSMs fail.

Soil samples will be collected by hand from biased sampling locations using various drilling methods (e.g., rotosonic, rotary, hollow-stem auger, or other applicable methods), direct-push, hand/power auger, and/or excavation, as appropriate. Table 3-3 provides the analytical methods to be used when analyzing for the COPCs. All sampling activities and QA/QC requirements for field and laboratory environmental sampling will be conducted in compliance with the Industrial Sites QAPP (NNSA/NV, 2002a) and other applicable procedures. Other governing documents that will accompany the field documents include a current version of the contractor-specific HASP and an approved SSHASP, which will be prepared prior to the field effort.

As required by the DOE Integrated Safety Management System (ISMS) (DOE/NV, 1997), these documents outline the requirements for protecting the health and safety of the workers and the public, and procedures for protecting the environment. The ISMS program requires that site personnel take every reasonable step to reduce or eliminate the possibility of injury, illness, or accidents, and to protect the environment during all project activities. The following safety issues will be taken into consideration when evaluating the hazards and associated control procedures for field activities discussed in the SSHASP:

- Potential hazards to site personnel and the public include, but are not limited to: chemicals (e.g., petroleum hydrocarbons, VOCs, SVOCs, PCBs, and heavy metals), radionuclides, adverse and rapidly changing weather, remote location, and motor vehicle and heavy equipment operations.

- Proper training of all site personnel to recognize and mitigate the anticipated hazards.

- Work controls to reduce or eliminate the hazards including engineering controls, substitution of less hazardous materials, and personal protective equipment (PPE).

- Occupational exposure monitoring to prevent overexposures to hazards such as radionuclides, chemicals, and physical agents (e.g., heat, cold, high wind).

- Radiological surveying for alpha/beta and gamma emitters to minimize and/or control personnel exposures; use of the "as-low-as-reasonably-achievable" principle when dealing with radiological hazards.

- Emergency and contingency planning and communications including medical care and evacuation, decontamination, and spill control measures, and appropriate notification of project management.

4.2.1 Site Preparation Activities

Site preparation will be conducted by the NTS Management and Operating (M&O) contractor prior to the investigation. Site preparation may include, but not be limited to: removal and proper disposal of surface debris (e.g., surface metal and wood debris) in the three sites that may interfere with sampling as preparation of sample access points (e.g., fence removal). At CAS 03-20-05, site access may require the partial demolition of the overhead crane support stem and removal of the steel housing over the injection well at the BOP Shop.

4.2.1.1 Initial (Phase I) Activities

The objective of the Phase I strategy is to initially determine the subsurface extent of TPH, VOCs, and SVOCs identified during previous investigations and to determine if other chemical or radiological COCs are present within a CAS boundary and to determine the surface, near-surface, and deep subsurface extent of contaminants. The initial activities planned for CAU 322 will include site surveys, surface/near-surface soil sampling, and deep subsurface soil sampling.

Visual inspections of the proposed study area at each CAS within CAU 322 will provide biasing factors for locating soil samples and to identify any potential conditions that may affect sampling and sample locations. The results of the radiological surveys for CASs 03-25-03 and 03-20-05 will be used to identify potential radiological health hazards, identify the need for additional radiological surveys, and provide safety information to protect workers and the environment during the CAI for CAU 322. Because the CAU 34 sampling and previous investigative sample results indicated the presence of TPH in much of CAS 03-25-03, the initial soil sampling will serve Phase II (extent) sampling.

The presence of chemical and radiological COCs will be determined by biased sampling and laboratory analyses. A comparison of laboratory analytical results from this phase against PALs will be used to confirm the presence or absence of chemical COCs.

Biased sampling locations will be determined based on the results of surveys and other biasing factors. The Site Supervisor has the ability to modify these locations and minimize samples submitted for laboratory analyses, but only if the decision needs and criteria stipulated in Appendix A.1, Section A.1.3, are satisfied.

The Phase I sampling strategy targets location and media most likely to be contaminated by COCs. The available laboratory results indicate the presence of TPH throughout CAS 03-25-03, Areas A and B. At CAS 03-20-05 the results indicated the presence of TPH, VOCs and SVOCs in the holding tank sludge and injection well sediments as well as other contaminants. Contaminants were not identified during preliminary assessment soil sampling for CAS 01- 25-01. Appendix A.1 lists the target populations for Phase I and identifies information needs in selecting data collection locations for Phase I decisions. The following are the biasing factors that currently have been identified for consideration in the selection of the surface soil sample locations:

- Aerial photograph review and evaluation
- Visual indicators (e.g., staining, topography, areas of preferential surface runoff)
- Existing site-specific analytical data (Bechtel Nevada [BN] and CAU 34 sampling data)
- Known or suspected sources and locations of release
- Process knowledge and experience at similar sites
- Information and/or data from adjacent CASs (e.g., CAS 03-44-02)
- Information from former site workers
- Geologic and/or hydrologic conditions
- Physical and chemical characteristics of suspected contaminants

Contaminants determined not to be present in Phase I samples may be eliminated from Phase II analytical suites. However, the initial surface soil samples will be analyzed for the full suite of parameters identified in Table 3-2.

4.2.1.2 Phase II Activities

Phase II (step-out) sampling locations at each CAS will be selected based on the outer boundary sample locations where a COC is detected in the initial surface soil confirmatory samples. Sample locations may be changed based on current site conditions, obvious debris or staining of soils, field-screening results, or professional judgment. Phase II locations will also be selected based on pertinent features of the CSM and the other biasing factors. If biasing factors indicate a COC potentially extends beyond planned Phase II sample locations, locations may be modified or additional Phase II samples may be collected from incremental step-out locations. Both surface and subsurface soil samples may be collected and analyzed to determine the extent of a COC.

Due to the nature of buried features possibly present (e.g., structures, buried debris, and utilities), sample locations may be relocated based upon the review of engineering drawings and information obtained during the site visit. However, the new locations will meet the decision needs and criteria stipulated in Section A.1.4.1.

Phase II subsurface soil samples will be collected at biased locations by hand augering, direct-push, excavation, or drilling techniques, as appropriate. Subsurface soil sample depth intervals will be selected based on biasing factors. Section 3.0 provides the analytical methods and laboratory requirements (i.e., detection limits, precision, and accuracy requirements) to be used when analyzing the COPCs. The analytical program for each CAS is presented in Table 3-2.

The following outlines the CAS-specific Phase I sampling strategy target locations and media most likely to be contaminated by COCs. Appendix A.1 lists the target populations for Phase I. Section A.1.3.1 and Table A.1-5 identify the primary biasing factors and information needs in selecting data collection locations for Phase I decisions. Proposed Phase I sample locations are shown in site-specific figures, which are provided following the sampling description for each parcel of the CAS.

4.2.1.3 Radiological Surveys

A partial land radiological survey will be conducted at CASs 03-25-03, Mud Pit, and 03-20-05, BOP Shop. The surveys will be conducted to determine the presence of surficial gamma- and high-energy beta-emitting radiological contaminants exceeding site-specific background values. A combination of walk-over surveys using handheld instruments and drive-over surveys using a vehicle-mounted detector will be performed. A plastic scintillator will be used as the instrument for the walkover and drive-over surveys. Additional equipment and software that will be used in the radiological data collection and processing include a Trimble™ global positioning system (GPS) receiver, laptop computer to log and process the walkover and driveover radiological data, and Surfer™ to plot the data.

4.2.1.4 Intrusive Investigation

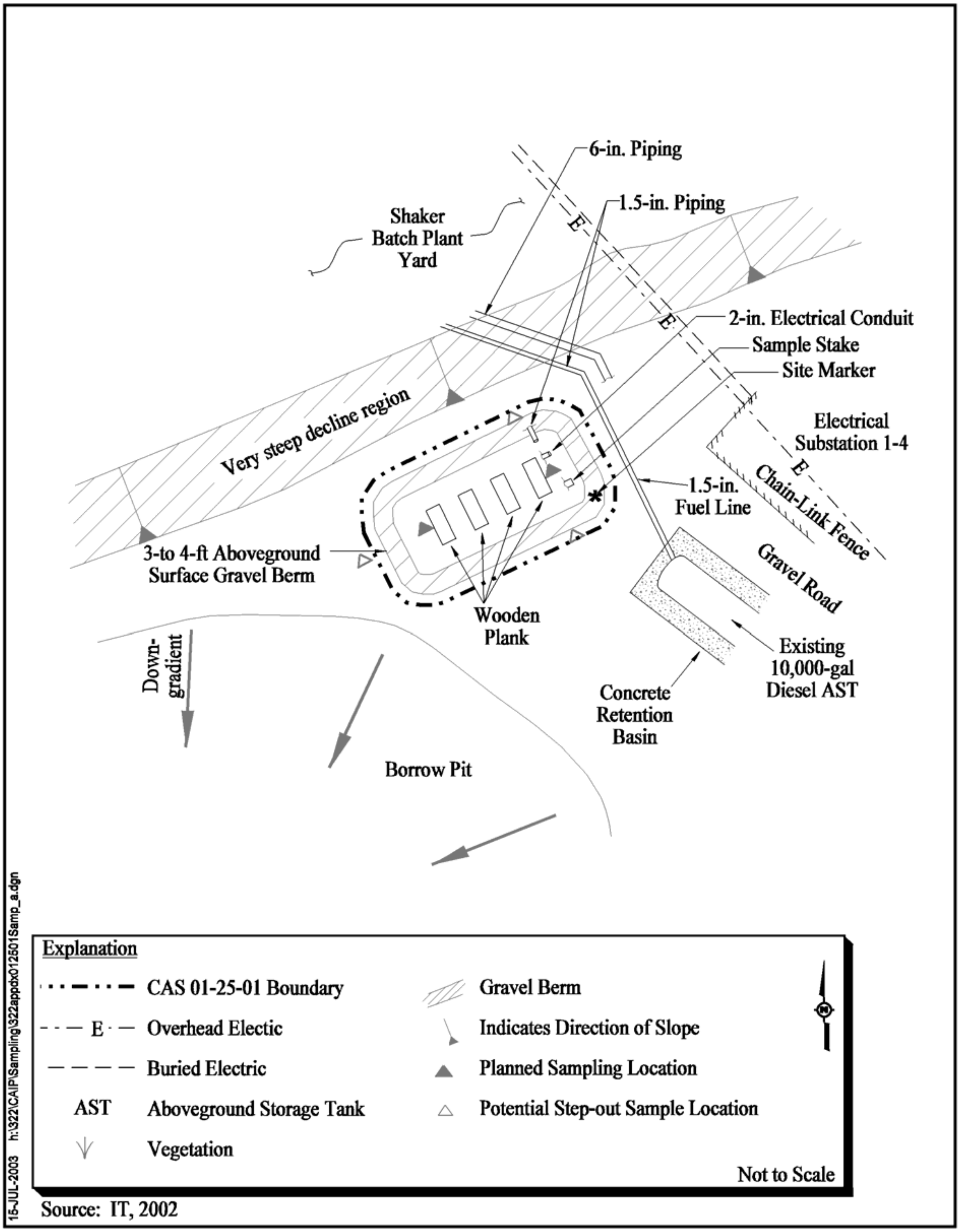
Drilling is expected to be the method of investigation to collect near-surface and subsurface soil samples, and to define vertical and lateral extent of contamination in identified and possible contamination areas. Select samples will be submitted for laboratory analysis for the Phase I chemical parameters identified for each CAS in Section 3.2. Analytical requirements are listed in Table 3-2. Laboratory volume requirements are laboratory-specific and will be described in the contractor's CAU 322 work instructions. Quality assurance and QC requirements for sample collection are discussed in Section 6.0.

The sampling plan figures depict possible soil sampling locations at each of the CAS areas. The number and actual sample locations shown on these figures are for illustration, and the actual locations and number may change. However, all changes will be thoroughly documented in the field activity daily logs (FADLs). Sample locations will be determined from current site conditions based on biasing factors. Samples will be submitted for laboratory analysis as discussed in Section 3.0.

Sampling at the AST Release, CAS 01-25-01

The initial activities to be conducted will be a visual inspection and photodocumentation of CAS 01-25-01. The visual inspection will focus on identifying evidence of contamination at the gravel containment pit resulting from a failure or leak from the former AST. The information generated during these initial activities will be used to provide additional biasing factors for the placement of soil samples.

A minimum of two samples will be collected at two locations to investigate the vertical and lateral extent of contamination in the gravel containment pit. Additional sample locations in the gravel containment pit will be added at the discretion of the Site Supervisor and based on FSR. Proposed sample locations are shown on Figure 4-1.



Source: IT, 2002

Figure 4-1
Sampling Plan for CAS 01-25-01, AST Release

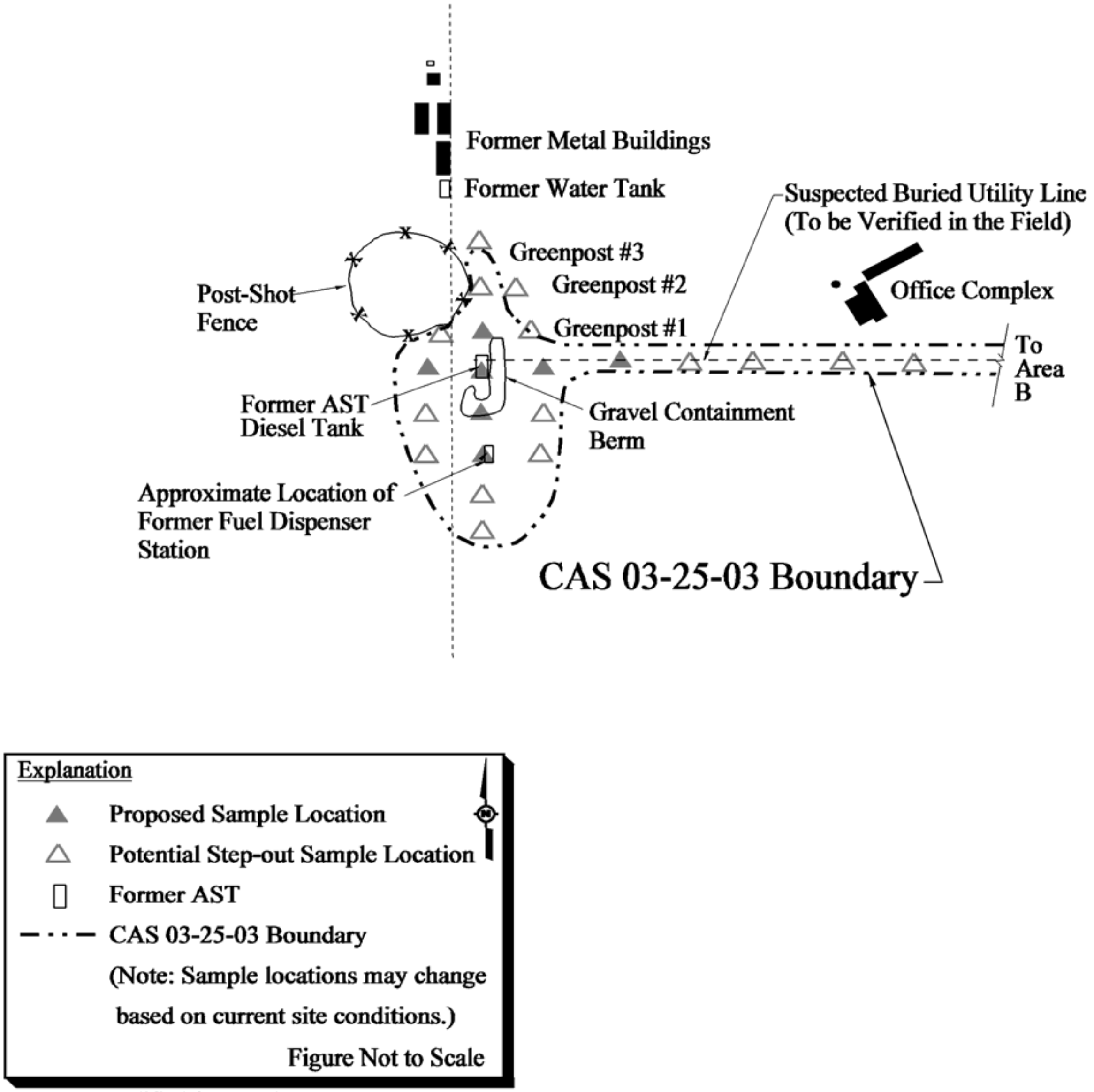
The first sample locations will correspond with the ends of the former tank and beneath the former piping. Samples will be collected at the gravel-soil interface (0 to 0.5 feet bgs) and at approximately 1-ft vertical intervals to a depth at least 2 ft below the bottom of the server tank at these locations. Additional samples will be collected, at the discretion of the Site Supervisor, to adequately characterize the nature and extent of potential contamination. The samples will be submitted to the laboratory for quick-turnaround analysis. If COCs are detected or suspected, additional soil samples from deeper intervals (Phase II samples) at the existing locations or from step-out locations will be collected to define the extent of contamination.

Three Phase II step-out sample locations for both vertical and horizontal samples are arranged around the perimeter of the gravel containment berm. Additional samples will be collected to delineate the extent of the potential isolated areas of contamination and will be based on the discretion of the Site Supervisor, laboratory analysis, and other biasing factors. Depending on the results of the screening, additional step-outs will be performed, as necessary.

Sampling at the Mud Plant AST Diesel Release, CAS 03-25-03

Area A: Phase I activities will be performed to confirm the nature of TPH contamination and other suspected contaminants that may have originated from a former AST and fuel dispenser. Initial activities will include a walkover radiological land-area survey, a visual inspection, and photo documentation of the ground surface within the CAS 03-25-03 boundaries. The initial surveys will be performed to ensure worker health and safety within the entire CAS boundary as permitted by site accessibility, terrain, and field conditions. The visual inspection will focus on identifying evidence of contamination at the containment pit and former fuel dispenser (“Area A”) resulting from a failure or leak from the former AST and fuel dispenser. The information generated during these initial activities will be used to provide additional biasing factors for the placement of soil samples.

Following visual inspection and the radiological survey, a minimum of seven soil sample locations will be identified along two transects that transverse Area A. The transect locations consider the former investigation results where TPH is known to be present, the need to determine if TPH contamination is present throughout Area A or limited to a small area within the Area A boundary. Figure 4-2 shows a generalized sampling plan for sample locations within Area 1 at CAS 03-25-03. This effort will use the data from previously collected samples and other biasing factors to identify



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Source: Modified from Holmes & Narver, 1979

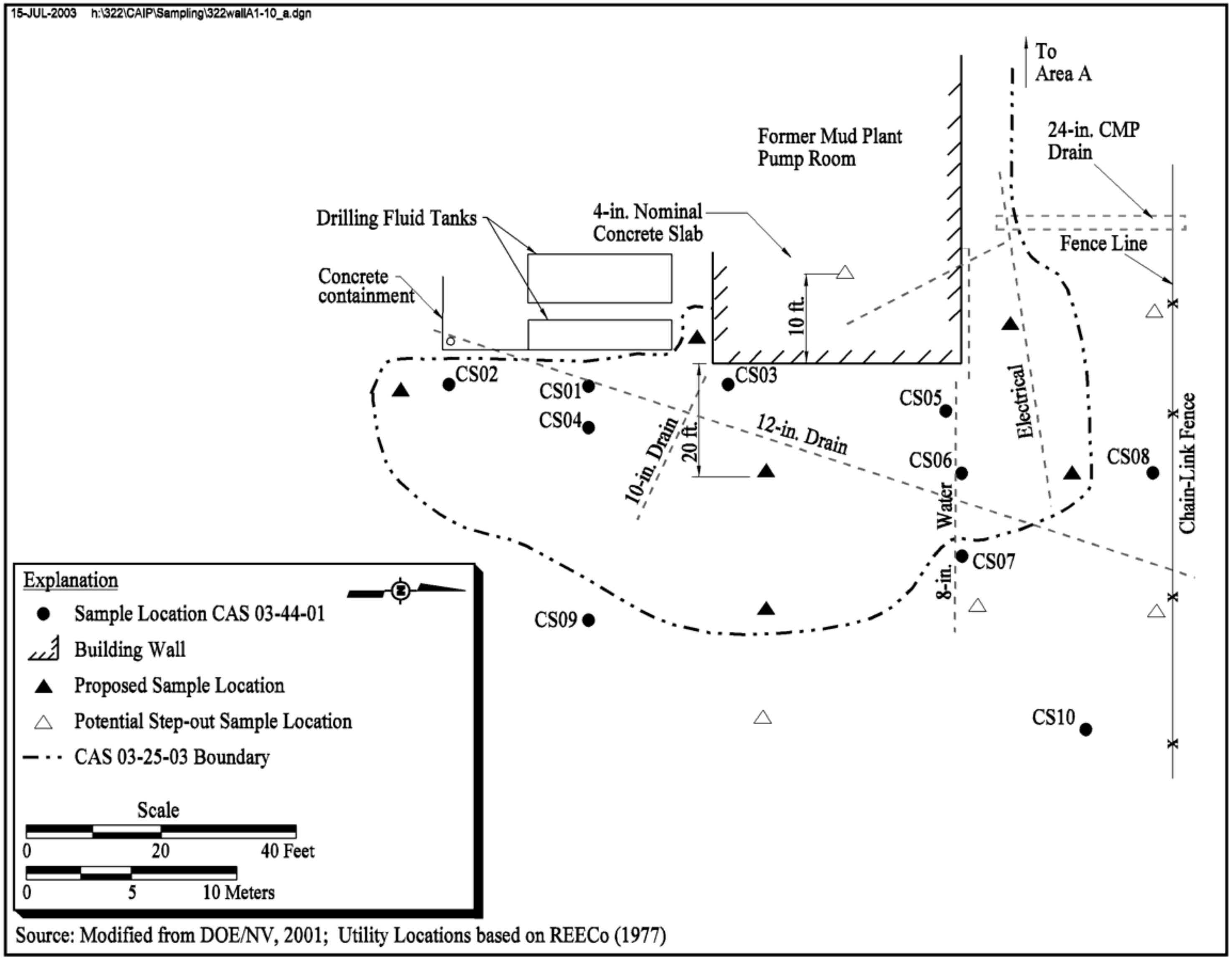
Figure 4-2
Sample Location Plan Area A CAS 03-25-03,
Mud Plant AST Diesel Release

sampling points within Area A. Previous analytical data may be used in the decision process if the data meets the quality criteria specified in this DQO process. Additional sampling points will be established at 25- to 50-ft lateral step-out locations moving away from the containment pit area in all directions depending on the results of the initial sampling. Step-out locations will also be identified moving east from the containment pit towards the former Mud Plant and along the alignment of suspected utilities. Although the step-out sampling is generally considered to be Phase II activities, these samples may be collected during the initial sampling event.

Sample locations and intervals have been selected based on the previous analytical data and documentation of TPH-contaminated soil. According to previously collected analytical data, the interval of 12- to 16-ft bgs is the interval where the PAL was exceeded for TPH. Samples will be collected at the 1- to 2-ft, 5- to 7-ft intervals, and at 2-ft intervals from 9- to 20-ft bgs. If laboratory data exceed the PAL at 20 ft bgs, additional soil samples will be collected below 20 ft bgs at 2-ft intervals to define the vertical extent of contamination identified. Additional locations may be sampled based on laboratory data or at the discretion of the Site Supervisor.

Area B: Similar to Area A of CAS 03-25-03, Phase I activities will be performed at Area B in the area east of the Mud Plant building. Initial activities will be performed to confirm the nature of the identified TPH DRO contamination and other suspected contaminants that may have originated from a petroleum hydrocarbon release related to previous site activities including the use of diesel generators, migration of petroleum hydrocarbons along a utility alignment, and the potential use of petroleum hydrocarbon products for dust suppression activities. Initial activities will include a walkover radiological land-area survey, a visual inspection and photodocumentation of the ground surface within the Area B boundary.

Initial activities will include the collection of surface and shallow subsurface soil samples. Surface samples (0- to 2-ft bgs) and subsurface samples (5- to 15-ft bgs) will be collected at eight soil sampling locations to resolve Decision I (nature of contamination) and to provide some initial confirmation on the lateral extent of the TPH DRO contamination identified in CAU 34 sampling. These samples will be submitted to the laboratory for quick-turnaround analysis. Figure 4-3 depicts the CAU 34 sample locations at Area B of CAS 03-25-03.



Source: Modified from DOE/NV, 2001; Utility Locations based on REECo (1977)

Figure 4-3
Sample Location Plan for Area B CAS 03-25-03, Mud Plant AST Diesel Release

Where TPH exceed the PAL in the soil samples based on quick turn-around analysis and previous sampling results, subsurface soil sampling from deeper intervals at existing locations or at the discretion of the Site Supervisor will be collected to define the vertical extent of contamination and resolve the Phase II decision.

If COCs other than TPH are detected or suspected, additional Phase II soil samples from step-out locations will be collected to define the extent of contamination.

At locations where Phase I analytical results show COPC concentrations in soil equal to or greater than PAL (both vertical and horizontal) samples will be collected during the Phase II sampling to delineate the extent of the potential contamination. Step-outs will continue until the extent of COC concentrations is less than or equal to PAL.

Sampling at the Injection Wells, CAS 03-20-05

Initial activities to be conducted will be a visual inspection and photodocumentation of CAS 03-20-25. The visual inspection will focus on identifying evidence of contamination on the BOP concrete floor resulting from spills during the routine cleaning of the blowout preventer equipment and evidence of contamination at the injection well. The information generated during these initial activities will be used to provide additional biasing factors for the placement of surface soil samples.

A minimum of three borings will be drilled for collection of deep subsurface samples to investigate the presence of potential contamination at the holding tanks and sumps at the BOP Shop and in the injection well, as shown on Figure 4-4. Additional holes may be drilled at the discretion of the Site Supervisor based on site-specific conditions.

To determine if contamination has been released to the deep subsurface soil, three deep borings will be located along the north and east sides of the BOP Shop in close proximity to the holding tanks and sumps and adjacent to the injection well. The sample locations were selected in areas where suspected COCs are present. A rotary drill rig method or equivalent will be used to collect soil samples at the deep boring locations. These borings will be advanced to a minimum depth of 100-ft bgs. Below a depth of 100 ft, these borings will be advanced until FSRs at two consecutive intervals are below FSLs. Subsurface soil samples will be collected at intervals of either 5, 10, or

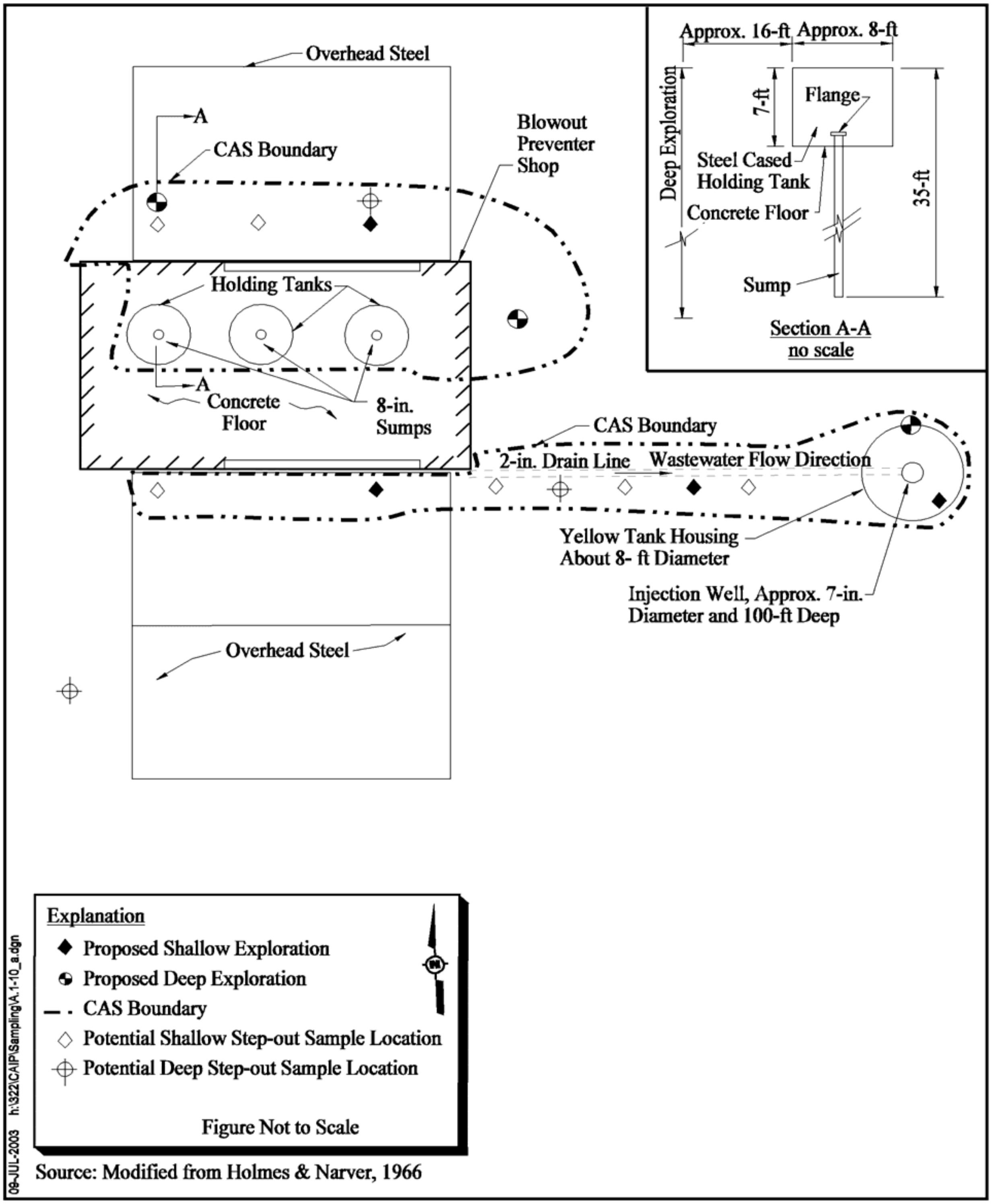


Figure 4-4
Sample Location Plan CAS 03-20-05, Injection Well
Blowout Prevention Shop/PS Pad Area 3 Camp

20 ft depending on FSRs, other site-specific conditions or observations, or at the discretion of the Site Supervisor.

To investigate the lateral extent of potential contamination from the injection well and holding tanks with sumps, the three deep borings will be located in a radial-pattern from the injection well and holding tanks. Spacial distance between the borings is approximately 50 ft on center, or at the discretion of the Site Supervisor, based on visual observation and FSRs. Assuming the subsurface soil is homogeneous and horizontal permeability is uniform through the stratum, a discharge of fluid from the injection well and/or holding tank sump is expected to disperse in an uniform radial pattern outward from the source. The pattern of the deep borings will determine if contamination is present and evaluate lateral extent of potential contamination.

In addition, a minimum of four locations will be identified for the collection of Phase II surface soil samples to investigate the lateral extent of surface contamination at the CAS. The samples will be collected near the entrances to the BOP Shop (edge of concrete slab), along the alignment of a suspected buried drain line, 2-in., and within the injection well vault. The locations consider the possible presence of contaminants based on process knowledge and available data. Additional surface and near-surface soil samples will be established at 15- to 50-ft lateral Phase II step-out locations moving across the outside edge of the BOP Shop and injection well.

Surface (0- to 0.5-ft bgs) samples will be collected at each of the points, and one below grade sample will be collected at the injection well vault (approximately 3.5 ft bgs).

Soil samples will be field screened for VOCs and these samples will be submitted to the laboratory for quick-turnaround analysis. If identified COCs and/or suspected COPCs exceed PALs in the soil samples, Phase II subsurface soil samples will be collected from deeper intervals at existing locations or from step-out locations to define the extent of contamination.

A radiological survey of the building floor, interior walls of the holding tanks, and the interior walls of the well vault will be conducted to identify any radioactive hot spots. A hot spot on the concrete floor or the tank and the below grade holding tank walls will be defined as any reading exceeding 100 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) over background. If hot spots are identified on the floor or walls, samples may be collected at those locations for waste determination purposes. The Site Supervisor has the discretion of selecting sample locations that best represent potential contamination.

A minimum of two surface soil/sludge samples will be collected from within the injection well, well vault, and holding tanks for the purpose of waste characterization and waste profile preparation. The Site Supervisor has the discretion of selecting or modifying the locations based on results of the planned radiological walkover survey. In addition, a sample will be collected of the liquid waste in each of the holding tanks, if present, and the injection well, if present. Samples will be used for waste characterization and waste profile preparations. Both soil/sludge and liquid samples will be analyzed for VOCs, SVOCs, TPH, PCBs, radionuclides, total metals and TCLP metals; in addition, samples will be analyzed for TCLP, VOCs, and SVOCs, if required.

Sampling will not be performed on the structural frame and/or the concrete floor of the BOP Shop as the building structure is not considered a source of continuing contamination; therefore, it is not part of the CAS.

4.3 Field-Screening Levels

Field screening, along with other biasing factors, may help guide the selection of the most appropriate sampling location for collection of laboratory samples. The following FSLs may be used for on-site field screening:

- The radiological (alpha and beta/gamma) FSL of the mean background activity plus two times the standard deviation of the mean background activity collected from undisturbed locations within the vicinity of the site (Adams, 1998).
- VOC FSRs greater than 20 parts ppm, or 2.5 times background, whichever is greater.

Field-screening concentrations exceeding FSLs indicate potential contamination at that sample location. This information will be documented and the investigation will collect additional samples to delineate the extent of the contamination. Additionally, these data may be used to select confirmatory samples for submission to the laboratory.

4.4 Additional Phase II Sampling to Define the Extent of Contamination

If COCs are detected, step-out sampling may be necessary to properly define the extent of contamination (i.e., contaminant boundaries). Sample locations for determining lateral extent of contamination identified during the Phase I effort will be based on process knowledge, site observations, field-screening data, and Phase I analytical results (if available). The target populations at step-out locations will be limited to COPC concentrations above PALs for the samples that defined the nature of contamination. They will also be limited by previous extent samples that may continue to exceed PALs.

The depth intervals at subsurface locations will be based on biasing factors such as the presence of debris, staining, odor, FSRs, or professional judgment. Test pits may be excavated to further evaluate the potential that clean soil is present over contamination at CASs 01-25-01 and 03-25-03, and to assist in the collection of biased subsurface soil samples. For subsurface sampling locations, generally two consecutive soil samples with results below field-screening action levels are required to define the vertical extent of contamination. Generally, the uppermost "clean" sample from each location will be submitted for laboratory analysis.

Step-out samples are typically placed approximately 15 ft from the previous sample location or as described herein where COCs were detected. If biasing factors indicate that the COCs may extend beyond the typical 15-ft distance, the distance for the step-outs may be extended. As field data are generated, these locations may be modified, but only if the modified locations meet the decision needs and criteria stipulated in the DQOs. At each step-out location, soil samples will be collected at the depth(s) where COCs were encountered and from two depth intervals below the lowest depth where COCs were observed. These samples will be screened, and if the results are not greater than FSLs, one of these samples (typically the uppermost) will be submitted to the laboratory for analysis. Laboratory analysis is the only acceptable verification that extent has been determined. In general, samples submitted for laboratory analysis will be those that define the lateral and vertical extent of COCs.

4.4.1 Phase II Activities

Phase II will define the extent of COC contamination. The lateral and vertical extent of contamination will be bounded by a laboratory analytical soil sample showing COC concentrations below PALs.

The spatial boundaries that apply to this CAS in Phase II are defined in Section A.1.5.2. If the nature and/or extent of contamination is inconsistent with the CSM or if contamination extends beyond the identified spatial boundaries, work will be temporarily suspended, NDEP will be notified, and the investigation strategy will be reevaluated. As long as contamination is consistent with the CSM and is within the spatial boundaries, sampling will continue to define extent.

Biased soil samples collected from step-out sample locations at each parcel will be selected based on the outer boundary sample locations where COCs were detected, other biasing factors, and field/site conditions (e.g., limitations posed by steep terrain). If biasing factors indicate COCs extend beyond Phase II sample locations, further step-out locations may be necessary. As field data are generated, the Site Supervisor has the authority to modify these locations but only if the modified locations meet the decision needs and criteria stipulated in Section A.1.3. At each Phase II location, soil samples will be collected at the depth(s) and 2 ft below the lowest depth where COCs were encountered. If the step-out locations from different original locations approach each other, the Site Supervisor may consider this as one area, and collect samples only in the outward directions.

In general, samples submitted for off-site analysis will be those that define the nature and extent (lateral and vertical) of COCs.

CAS 03-25-03, Area B: Samples will be collected during the Phase II sampling to delineate the extent of the potential contamination identified during the Phase I investigation. During Phase II, step-out sample locations will be selected based on biasing factors (i.e., analytical data, field observations). Initial step-outs will be located beside the Phase I sample locations where COCs were detected. At each Phase II location, soil samples will be collected at the depth where COCs were encountered in Phase I, and at Phase II sample intervals below the lowest depth where COCs were encountered. Confirmation samples will be selected as previously discussed. Depending on the results of the screening, additional step-outs will be located based on the site-specific biasing factors.

Potential step-out locations have been selected based on field observations, review of existing analytical data, and physical constraints at the site. Additional locations may be sampled based on FSRs or at the discretion of the Site Supervisor.

CAS 03-20-05: The initial Phase II investigation efforts will consist of further characterizing the site where COCs have been confirmed to be present. Step-out (both vertical and horizontal) sampling points will be established and samples will be collected during the Phase II sampling to delineate the extent of contamination identified during Phase I. During Phase II, step-out sample locations will be selected based on biasing factors and Phase I results and located on the three sides of the locations where COCs were detected. At each Phase II location, soil samples will be collected at the depth where COCs were encountered in Phase I and at 2 ft below the lowest depth where COCs were encountered. Confirmation samples will be selected as previously discussed. Depending on the results of the screening, additional step-outs will be performed, as necessary. Figure 4-2 shows a generalized sampling plan at CAS 03-20-05.

Phase II sampling for CAS 01-25-01 will be based on the results of the Phase I sampling.

4.5 Field-Screening Levels

Field screening, along with other biasing factors, may help guide the selection of the most appropriate sampling location for collection of laboratory samples. The following FSLs may be used for on-site field screening:

- The radiological (alpha and beta/gamma) FSL of the mean background activity plus two times the standard deviation of the mean background activity collected from undisturbed locations within the vicinity of the site (Adams, 1998).
- VOC FSRs greater than 20 parts ppm or 2.5 times background, whichever is greater.

Field-screening concentrations exceeding FSLs indicate potential contamination at that sample location. This information will be documented and the investigation will collect additional samples to delineate the extent of the contamination. Additionally, these data may be used to select confirmatory samples for submission to the laboratory.

4.6 Geotechnical/Hydrological Analysis and Bioassessment Tests

It may be necessary to measure the geotechnical/hydrological parameters of a CAS. Bioassessment samples may be collected if biasing factors suggest a petroleum plume may be present. Samples to be analyzed for these parameters will be collected within brass sleeves (or other containers, as appropriate) to maintain the natural physical characteristics of the soil. Table 4-1 lists general geotechnical and hydrological parameters of interest. The testing methods shown are minimum standards, and other equivalent or superior testing methods may be used. In some cases, bioassessment will also be performed on the sample material. Bioassessment is a series of tests designed to evaluate the physical, chemical, and microbiological characteristics of a site. Bioassessment tests include determinants of nutrient availability, pH, microbial population density, and the ability of the microbial population to grow under enhanced conditions. This type of analysis is most appropriate for hydrocarbon contamination sites where bioremediation is a potential corrective action.

Table 4-1
General Geotechnical and Hydrological Analysis

Geotechnical Parameter	Methods
Initial moisture content	ASTM[a] D 2216-92
Dry bulk density	ASTM[a] D 2937-94
Calculated porosity	EM[b]-1110-2-1906 or MOSA[c] Chp. 18
Saturated hydraulic conductivity	ASTM[a] 2434-68(74) MOSA[c] Chp. 28
Unsaturated hydraulic conductivity	van Genuchten[d]
Particle-size distribution	ASTM[a] D 422-63(90)
Water-release (moisture retention) curve	MOSA[c] Chp. 26 ASTM[a] D 2325-68(94) MOSA[c] Chp. 24 Karanthanasis and Hajek[e]

[a] ASTM, 1996
[b] USACE, 1970
[c] Methods of Soil Analysis (MOSA) (Soil Science Society of America, 1986)
[d] van Genuchten, 1980
[e] Karathanasis and Hajek, 1982

5.0 Waste Management

Management of IDW will be based on regulatory requirements, field observations, process knowledge, and the results of laboratory analysis of CAU 322 investigation samples.

Disposable sampling equipment, PPE, and rinsate are considered potentially contaminated waste only by virtue of contact with potentially contaminated media (e.g., soil), potentially contaminated structures (e.g., vault walls), or former process liquids (i.e., equipment cleaning solution). Therefore, sampling and analysis of IDW, separate from analyses of site investigation samples, may not be necessary for all IDW. However, if associated investigation samples are found to contain contaminants above regulatory levels, direct samples of IDW may be taken to support waste characterization.

Sanitary, hazardous, radioactive, and/or mixed waste, if generated, will be managed and disposed of in accordance with DOE Orders, U.S. Department of Transportation (DOT) regulations, state and federal regulations, and agreements and permits between the DOE and NDEP.

5.1 Waste Minimization

Investigation activities are planned to minimize IDW generation. This will be accomplished by incorporating the use of process knowledge, visual examination, and /or radiological survey and swipe results. When possible, disturbed media (such as soil removed during excavation activities) or debris will be returned to its original location. Contained media (e.g., soil managed as waste) as well as other IDW will be segregated to the greatest extent possible to minimize generation of hazardous or mixed waste. Other hazardous materials used at sites will be controlled. Administrative controls, including decontamination procedures and waste characterization strategies, will minimize waste generated during investigations.

5.2 Potential Waste Streams

Waste generated during the investigation activities will include the following potential waste streams:

- Environmental media (e.g., soil)

- Surface debris in the investigation area
- PPE and disposable sampling equipment (e.g., plastic, paper, sample containers, aluminum foil, spoons, bowls)
- Decontamination rinsate
- Field-screening waste (e.g., soil, spent solvent, rinsate, disposable sampling equipment, and PPE contaminated by field-screening activities)

Office trash and lunch waste will be sent to the sanitary landfill by placing the waste in a dumpster. Each waste stream generated will be reviewed and segregated at the point of generation.

5.3 Investigation-Derived Waste Management

The on-site management and ultimate disposition of IDW may be guided by several factors, including, but not limited to: the analytical results of samples either directly or indirectly associated with the waste, historical site knowledge, knowledge of the waste generation process, field observations, field-monitoring/screening results, and/or radiological survey/swipe results. Table 4-2 of the current *NV/YMP Radiological Control Manual* (DOE/NV, 2000d) shall be used to determine if such materials may be declared nonradioactive. On-site IDW management requirements by waste type are detailed in the following sections. Applicable waste management regulations and requirements are listed in Table 5-1.

5.3.1 Sanitary Waste

Office trash and lunch waste will be placed in the dumpster to be transported to the sanitary landfill for disposal.

Sanitary IDW generated at each CAS will only be collected in plastic bags, sealed, labeled with the CAS number from each site in which it was generated, and dated. The waste will then be placed in a roll-off box located in Mercury, or other approved roll-off box location. The number of bags of sanitary IDW placed in the roll-off box will be counted as they are placed in the roll-off box, noted in a log, and documented in the FADL. These logs will provide necessary tracking information for ultimate disposal in the 10c Industrial Waste Landfill or other approved landfill.

Table 5-1
Waste Management Regulations and Requirements

Waste Type	Federal Regulation	Additional Requirements
Solid (nonhazardous)	NA	NRS 444.440 - 444.620[a] NAC 444.570 - 444.7499[b] NTS Landfill Permit SW13.097.04[c] NTS Landfill Permit SW13.097.03[d]
Liquid/Rinsate (nonhazardous)	NA	Water Pollution Control General Permit GNEV93001, Rev. 3iii[e]
Hazardous	RCRA[f]	NRS 459.400 - 459.600[g] NAC 444.850 - 444.8746[h] POC[i]
Low-Level Radioactive	10 CFR 61	DOE Orders and NTSWAC[j]
Mixed	RCRA[f]	NTSWAC[j] POC[i]
Hydrocarbon	NA	NAC 445A.2272[k] NTS Landfill Permit SW13.097.02[l]
Polychlorinated Biphenyls	TSCA[m]	NRS 459.400 - 459.600[g] NAC 444.940 - 444.9555[o]
Asbestos	TSCA[n] 29 CFR 1926, 1101[q]	NAC 444.965-444.976[p]

[a] *Nevada Revised Statutes* (NRS, 2001a)
[b] *Nevada Administrative Code* (NAC, 2002a)
[c] Area 23 Class II Solid Waste Disposal Site (NDEP, 1997a)
[d] Area 9 Class III Solid Waste Disposal Site (NDEP, 1997c)
[e] Nevada Test Site Sewage Lagoons (NDEP, 1999)
[f] *Resource Conservation and Recovery Act* (CFR, 2002a)
[g] *Nevada Revised Statutes* (NRS, 2001b)
[h] *Nevada Administrative Code* (NAC, 2002b)
[i] *Performance Objective for the Certification of Nonradioactive Hazardous Waste* (BN, 1995)
[j] *Nevada Test Site Waste Acceptance Criteria*, Revision 4 (NNSA/NV, 2002b)
[k] *Nevada Administrative Code* (NAC, 2002e)
[l] Area 6 Class III Solid Waste Disposal Site for Hydrocarbon (NDEP, 1997b)
[m] *Toxic Substance Control Act* (CFR, 2002b)
[n] *Toxic Substance Control Act* (CFR, 2002c)
[o] *Nevada Administrative Code* (NAC, 2002c)
[p] *Nevada Administrative Code* (NAC, 2002d)
[q] Occupational Safety and Health Administrative (CFR, 2002d)

NA = Not applicable
NAC = *Nevada Administrative Code*
NRS = *Nevada Revised Statutes*
NTS = Nevada Test Site
RCRA = *Resource Conservation and Recovery Act*
NTSWAC = *Nevada Test Site Waste Acceptance Criteria*
TSCA = *Toxic Substance Control Act*
POC = *Performance Objective for the Certification of Nonradioactive Hazardous Waste*

5.3.1.1 Special Sanitary

Hydrocarbon waste is defined as waste containing more than 100 mg/kg of TPH contamination (NAC, 2002e). Hydrocarbon waste will be managed on site in a drum or other appropriate container until fully characterized. Hydrocarbon waste may be disposed of at a designated hydrocarbon landfill (NDEP, 1997b), an appropriate hydrocarbon waste management facility (e.g., recycling facility), or other method in accordance with applicable Nevada regulations.

Regulated asbestos-containing materials (ACM) that may be encountered or generated during this investigation will be managed and disposed of in accordance with appropriate federal (CFR, 2002c) and State of Nevada 444.921 (NAC, 2002d) regulations.

Materials that are thought to potentially contain the hantavirus will be managed and disposed of in accordance with appropriate health and safety procedures.

5.3.2 Hazardous Waste

The CAU will have waste accumulation areas established according to the needs of the project. Satellite accumulation areas (SAAs) and hazardous waste accumulation areas (HWAAs) will be managed consistent with the requirements of Federal and State regulation. (CFR, 2002a; NAC, 2002b). The HWAAs will be properly controlled for access and will be equipped with spill kits and appropriate spill containment. Suspected hazardous wastes will be placed in DOT-compliant containers. All containerized waste will be handled, inspected, and managed in accordance with Title 40 CFR 265 Subpart I. (CFR, 2002a). These provisions include managing the waste in containers compatible with the waste type, and segregating incompatible waste types so that in the event of a spill, leak, or release, incompatible wastes shall not contact one another.

The HWAAs will be covered under a site-specific emergency response and contingency action plan until such time that the waste is determined to be nonhazardous or all containers of hazardous waste have been removed from the storage area. Hazardous waste will be characterized in accordance with the requirement of Title 40 CFR 261. *Resource Conservation and Recovery Act*- “listed” waste has not been identified at CAU 322. Any waste determined to be hazardous will be managed and transported in accordance with RCRA and DOT requirements to a permitted treatment, storage, and disposal facility (CFR, 2002a).

Analyses that may be required for the disposal of IDW and respective regulatory levels are identified in Table 3-4.

Management of Personal Protective Equipment and Disposable Sampling Equipment - PPE and disposable sampling equipment will be visually inspected for stains, discoloration, and gross contamination as the waste is generated, and also evaluated for radiological contamination. Staining and/discoloration will be assumed to be the result of contact with potentially contaminated media such as soil, sludge, or liquid. Gross contamination is the visible contamination of an item (e.g., clumps of soil/sludge on a sampling spoon or free liquid smeared on a glove). While gross contamination can often be removed through decontamination methods, removal of gross contamination from small items, such as gloves or booties is not typically conducted. Any IDW that meets this description will be segregated and managed as potentially "characteristic" hazardous waste. This segregated population of waste will either be: (1) assigned the characterization of the soil/sludge that was sampled, (2) sampled directly, or (3) undergo further evaluation using the soil/sludge sample results to determine how much soil/sludge would need to be present in the waste to exceed regulatory levels. Waste that is determined to be hazardous will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. The PPE and equipment that is not visibly stained, discolored, or grossly contaminated will be managed as nonhazardous sanitary waste.

Management of Decontamination Rinsate - Rinsates at CAU 322 will not be considered hazardous waste unless there is evidence that the rinsate would display a RCRA characteristic. Evidence may include such things as the presence of a visible sheen, pH, or association with equipment/materials used to respond to a release/spill of a hazardous waste/substance. Decontamination rinsate that is potentially hazardous (using associated sample results and/or process knowledge) will be managed as "characteristic" hazardous waste (CFR, 2002a). The regulatory status of the potentially hazardous rinsate will be determined through the application of associated sample results or through direct sampling. If determined to be hazardous, the rinsate will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. If the associated samples do not indicate the presence of hazardous constituents, then the rinsate will be considered to be nonhazardous.

The disposal of nonhazardous rinsate will be consistent with guidance established in current NNSA/NSO Fluid Management Plans for the NTS as follows:

- Rinsate that is determined to be nonhazardous and contaminated to less than 5x *Safe Drinking Water Standards* (SDWS) is not restricted as to disposal. Nonhazardous rinsate, which is contaminated at 5x to 10x SDWS, will be disposed of in an established infiltration basin, or solidified and disposed of as sanitary or low-level waste in accordance with the respective sections of this document.
- Nonhazardous rinsate, which is contaminated at greater than 10x SDWS, will be disposed of in a lined basin, or solidified and disposed of as sanitary or low-level waste in accordance with the respective sections of this document.

Management of Soil - This waste stream consists of soil produced during soil sampling, excavation, and/or drilling. This waste stream is considered to have the same COPCs as the material remaining in the ground. The preferred method for managing this waste stream is to place the material back into the borehole/excavation in the same approximate location from which it originated. If this cannot be accomplished, the material will either be managed on site by berming and covering next to the excavation, or by placement in a container(s). The disposal of soil may be deferred until implementation of corrective action at the site.

Management of Debris - This waste stream can vary on site conditions. Debris that requires removal for the investigation activities (e.g., soil sampling, excavation, and/or drilling) must be characterized for proper management and disposition. Historical site knowledge, knowledge of the waste generation process, field observations, field-monitoring/screening results, radiological survey/swipe results and/or the analytical results of samples either directly or indirectly associated with the waste will be used to characterize the debris. Debris will be visually inspected for stains, discoloration, and gross contamination. Debris may be deemed reusable, recyclable, sanitary waste, hazardous waste, PCB waste, or low-level waste. Waste that is not sanitary will be entered into an approved waste management system, where it will be managed and dispositioned according to federal requirements, state requirements, and agreements between NNSA/NSO and the State of Nevada. The debris will either be managed on site by berming and covering next to the excavation, by placement in a container(s), or left on the footprint of the CAS and its disposition deferred until implementation of corrective action at the site.

Field Screening Waste - The use of field test kits and/or instruments may result in the generation of small quantities of hazardous wastes. If hazardous waste is produced by field screening, it will be segregated from other IDW and managed in accordance with the hazardous waste regulations (CFR, 2002a). On radiological sites, this may increase the potential to generate mixed waste; however, the generation of a mixed waste will be minimized as much as practicable. In the event a mixed waste is generated, the waste will be managed in accordance with Section 5.3.5.

5.3.3 Polychlorinated Biphenyls

The management of PCBs is governed by the *Toxic Substances Control Act* (TSCA) (USC, 1976) and its implementing regulations at 40 CFR 761 (CFR, 2002b). Polychlorinated biphenyls contamination may be found as a sole contaminant or in combination with any of the types of waste discussed in this document. For example, PCBs may be a contaminant in soil that contains a RCRA "characteristic" waste (PCB/hazardous waste), or in soil that contains radioactive wastes (PCB/radioactive waste), or even in mixed waste (PCB/radioactive/hazardous waste). The IDW will initially be evaluated using analytical results for media samples from the investigation. If any type of PCB waste is generated, it will be managed according to 40 CFR 761 (CFR, 2002b) as well as State of Nevada requirements (NAC, 2002c), guidance, and agreements with NNSA/NSO.

5.3.4 Low-Level Waste

Radiological swipe surveys and/or direct-scan surveys may be conducted on reusable sampling equipment and the PPE and disposable sampling equipment waste streams exiting a radiologically controlled area. This allows for the immediate segregation of radioactive waste from waste that may be unrestricted regarding radiological release. Removal contamination limits, as defined in Table 4-2 of the current version of the *NV/YMP Radiological Control Manual* (DOE/NV, 2000d), will be used to determine if such waste may be declared unrestricted regarding radiological release versus being declared radioactive waste. Direct sampling of the waste may be conducted to aid in determining if a particular waste unit (e.g., drum of soil) contains low-level radioactive waste, as necessary. Waste that is determined to be below the values of Table 4-2, by either direct radiological survey/swipe results or through process knowledge, will not be managed as potential radioactive waste but will be managed in accordance with the appropriate section of this document. Waste in excess of Table 4-2 values will be managed as potential radioactive waste and be managed in accordance with this section and any other applicable sections of this document.

Low-level radioactive waste, if generated, will be managed in accordance with the contractor-specific waste certification program plan, DOE Orders, and the requirements of the current version of the *Nevada Test Site Waste Acceptance Criteria* (NTSWAC) (NNSA/NV, 2002b). Potential radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate may be staged at a designated radioactive materials area (RMA) or radiologically controlled area (RCA) when full or at the end of an investigation phase. The waste drums will remain at the RMA pending certification and disposal under NTSWAC requirements (NNSA/NV, 2002b).

5.3.5 Mixed Waste

Mixed waste, if generated, shall be managed and dispositioned according to the requirements of RCRA (CFR, 2002a) or subject to agreements between NNSA/NSO and the State of Nevada, as well as DOE requirements for radioactive waste. The waste will be marked with the words "Hazardous Waste Pending Analysis and Radioactive Waste Pending Analysis." Waste characterized as mixed will not be stored for a period of time that exceeds the requirements of RCRA unless subject to agreements between NNSA/NSO and the State of Nevada. The mixed waste shall be transported via an approved hazardous waste/radioactive waste transporter to the NTS transuranic waste storage pad for storage pending treatment or disposal. Mixed waste with hazardous waste constituents below Land Disposal Restrictions may be disposed of at the NTS Area 5 Radioactive Waste Management Site (RWMS) if the waste meets the requirements of the NTSWAC (NNSA/NV, 2002b), the NTS's NDEP permit for a Hazardous Waste Management Facility (NEV HW0009 [NDEP, 2000]), and the RCRA Part B Permit Application for Waste Management Activities at the Nevada Test Site (DOE/NV, 1999). Mixed waste not meeting land disposal restrictions will require development of a treatment and disposal plan under the requirements of the Mutual Consent Agreement between DOE and the State of Nevada (NDEP, 1995).

6.0 Quality Assurance/Quality Control

The primary objective of the corrective action investigation described in this CAIP is to collect accurate and defensible data to support the selection and implementation of a closure alternative for each CAS in CAU 322. The detailed discussion of the QA/QC requirements are presented in the Industrial Sites QAPP (NNSA/NV, 2002a). Section 6.4 and Section 6.5 of the QAPP discusses the collection of required QC samples in the field and QA requirements for laboratory/analytical data to achieve closure. Section 6.3 provides QA/QC requirements for radiological survey data. Data collected during the corrective action investigation will be evaluated against DQI-specific performance criteria to verify that the DQOs established during the DQO process (Appendix A.1) have been satisfied.

Unless otherwise stated in this CAIP or required by the results of the DQO process (Appendix A.1), this investigation will adhere to the QAPP (NNSA/NV, 2002a).

The discussion of the DQIs, including the data sets, will be provided in the CAU 322 CADD to be developed at the completion of the corrective action investigation.

6.1 Quality Control Field Sampling Activities

Field QC samples will be collected in accordance with approved procedures. Field QC samples are collected and analyzed to aid in determining the validity of sample results. The number of required QC samples depends on the types and number of environmental samples collected. The minimum frequency of collecting and analyzing QC samples for this investigation, as determined in the DQO process, include:

- Trip blanks (one per sample cooler containing VOC environmental samples)
- Equipment blanks (one per sampling event for each type of decontamination procedure)
- Source blanks (one per lot of source material that contacts sampled media)
- Field duplicates (minimum of one per matrix per 20 environmental samples)

- Field blanks (minimum of one per 20 environmental samples or one per sampling day, whichever best exemplifies field conditions)
- Matrix spike (MS)/matrix spike duplicate (MSD) (minimum of one each per matrix per 20 environmental samples), as required by method

Additional QC samples may be submitted based on site conditions at the discretion of the Site Supervisor. Field QC samples shall be analyzed using the same analytical procedures implemented for associated environmental samples. Additional details regarding field QC samples are available in the Industrial Sites QAPP (NNSA/NV, 2002a).

6.2 Laboratory/Analytical Quality Assurance

Criteria for the investigation, as stated in the DQOs (Appendix A.1) and except where noted, require laboratory analytical quality data be used for making critical decisions. Rigorous QA/QC will be implemented for all laboratory samples including documentation, data verification and validation of analytical results, and an assessment of DQIs as they relate to laboratory analysis.

6.2.1 Data Validation

Data verification and validation will be performed in accordance with the Industrial Sites QAPP (NNSA/NV, 2002a), except where otherwise stipulated in this CAIP. Asbestos samples will not be validated, although all other organic and inorganic laboratory data (i.e., nonradiological laboratory data) from samples collected and analyzed will be evaluated for data quality according to *EPA Contract Laboratory Program National Functional Guidelines* (EPA, 1994a and 1999).

Radiological laboratory data from samples that are collected and analyzed will be evaluated for data quality according to company-specific procedures. The data will be reviewed to ensure that all critical samples were appropriately collected, analyzed, and the results passed data validation criteria. Validated data, including estimated data (i.e., J-qualified), will be assessed to determine if they meet the DQO requirements of the investigation and the performance criteria for the DQIs. The results of this assessment will be documented in the CAU 322 CADD. If the DQOs were not met, corrective actions will be evaluated, selected, and implemented (e.g., refine CSM or resample to fill data gaps).

6.2.2 Data Quality Indicators

Data quality indicators are qualitative and quantitative descriptors used in interpreting the degree of acceptability or usability of data. The principal DQIs are precision, accuracy, representativeness, comparability, and completeness. A sixth DQI, sensitivity, has also been included for the CAU 322 investigation. Data quality indicators are used to evaluate the entire measurement system and laboratory measurement processes (i.e., analytical method performance) as well as to evaluate individual analytical results (i.e., parameter performance).

Precision and accuracy are quantitative measures used to assess overall analytical method and field-sampling performance as well as to assess the need to "flag" (qualify) individual parameter results when corresponding QC sample results are not within established control limits. Therefore, performance metrics have been established for both analytical methods and individual analytical results. Data qualified as estimated for reasons of precision or accuracy may be considered to meet the parameter performance criteria based on assessment of the data.

Representativeness and comparability are qualitative measures, and completeness is a combination of both quantitative and qualitative measures. Representativeness, comparability, and completeness are used to assess the measurement system performance. The DQI parameters are individually discussed in Section 6.2.3 through Section 6.2.8.

Table 6-1 provides the established analytical method/measurement system performance criteria for each of the DQIs and the potential impacts to the decision if the criteria are not met. The Industrial Sites QAPP (NNSA/NV, 2002a) documents the actions required to correct conditions that adversely affect data quality both in the field and the laboratory. All DQI performance criteria deficiencies will be evaluated for data usability and impacts to the DQO decisions. These evaluations will be discussed and documented in the data assessment section of the CAU 322 CADD. The following subsections discuss each of the DQIs that will be used to assess the quality of laboratory data.

6.2.3 Precision

Precision is used to assess the variability of a population of measurements with the variability of the analysis process. It is used to evaluate the performance of analytical methods as well as to evaluate the usability of individual analytical results. Precision is a measure of agreement among a replicate

Table 6-1
Laboratory and Analytical Performance Criteria for CAU 322 Data Quality Indicators

Data Quality Indicator	Performance Criteria	Potential Impact on Decision if Performance Criteria Not Met
Precision	Variations between duplicates (laboratory and field) and original sample should not exceed analytical method-specific criteria.	Data that do not meet the performance criteria will be evaluated for purposes of completeness. Decisions may not be valid if analytical method performance criteria for precision are not met.
Accuracy	Laboratory control sample results, matrix spike results, and surrogate spike results should be within specified acceptance windows.	Data that do not meet the performance criteria will be evaluated for purposes of completeness. Decisions may not be valid if analytical method performance criteria for accuracy are not met.
Sensitivity	Detection limits of laboratory instruments must be less than or equal to respective PALs.	Cannot determine if COCs are present or migrating at levels of concern; therefore, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives.
Comparability	Equivalent samples analyzed using same analytical methods, the same units of measurement and detection limits must be used for like analyses.	Inability to combine data with data obtained from other sources and/or inability to compare data to regulatory action levels.
Representativeness	Correct analytical method performed for appropriate COPC; valid data reflects appropriate target population.	Cannot identify COC or estimate concentration of COC; therefore, cannot make decision(s) on target population.
Nature Completeness	80% of the CAS-specific noncritical analytes identified in the CAIP have valid results. 90% of critical analytes are valid.	Cannot make decision on whether COCs are present.
Extent Completeness	90% of critical analytes used to define extent of COCs are valid.	Extent of contamination cannot be determined.
Clean Closure Completeness	90% of critical analytes are valid.	Cannot determine if COCs remain in soil.

set of measurements of the same property under similar conditions. This agreement is expressed as the relative percent difference (RPD) between duplicate measurements. The method used to calculate RPD is presented in the Industrial Sites QAPP (NNSA/NV, 2002a).

Determinations of precision will be made for field duplicate samples and laboratory duplicate samples. Field duplicate samples will be collected simultaneously with samples from the same source under similar conditions in separate containers. The duplicate sample is treated independently of the original sample in order to assess field impacts and laboratory performance on precision through a comparison of results. Laboratory precision is evaluated as part of the required laboratory internal QC program to assess performance of analytical procedures. The laboratory sample duplicates are an aliquot, or subset, of a field sample generated in the laboratory. They are not a separate sample but a split, or portion, of an existing sample. Typically, laboratory duplicate QC samples include MSD and laboratory control sample (LCS) duplicate samples for organic, inorganic, and radiological analyses.

6.2.3.1 Precision for Chemical Analysis

The RPD criteria to be used for assessment of precision are the parameter-specific criteria listed in Table 3-3. When laboratory-specific control limits are indicated, they are based on the evaluation at the laboratory on a quarterly basis by monitoring the historical data and performance for each method. No review criteria for field duplicate RPD comparability have been established; therefore, the laboratory sample duplicate criteria will be applied to the review of field duplicates.

The parameter performance criteria for precision will be compared to RPD results of duplicate samples. This will be accomplished as part of the data validation process. Precision values for organic and inorganic analyses that are within the established control criteria indicate that analytical results for associated samples are valid. The RPD values that are outside the criteria for organic analysis do not necessarily result in the qualification of analytical data. It is only one factor in making an overall judgment about the quality of the reported analytical results. For the purpose of data validation of inorganic analyses, precision is measured in two ways. The RPD is calculated when the sample and its duplicate results are greater than five times the contract-required detection limit (CRDL). The absolute difference is calculated and applied to the CRDL when the results are less than five times the CRDL. Inorganic laboratory sample duplicate RPD values outside the established control criteria result in the qualification of associated analytical results as estimated; however, qualified data does not necessarily indicate that the data are not useful for the purpose intended. This qualification is an indication that data precision should be considered for the overall assessment of the data quality and potential impact on data applicability in meeting site characterization objectives.

The criteria to evaluate analytical method performance for precision (Table 3-3) will be assessed based on the analytical method-specific (e.g., VOCs) precision measurements. The analytical method-specific precision measurement is calculated by taking the number of analyses meeting the RPD criteria, dividing that by the total number of analyses with detectable concentrations, and multiplying by 100. Each analytical method-specific precision measurement will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CAU 322 CADD.

6.2.3.2 Precision for Radiochemical Analysis

The parameter performance criteria for precision will be compared to the RPD or normalized difference (ND) results of duplicate samples. The criteria for assessment of the radiochemical precision are parameter-specific criteria (see Table 3-3). This assessment will be accomplished as part of the data validation process. Precision values that are within the established control criteria indicate that analytical results for associated samples are valid. Out of control RPD or ND values do not necessarily indicate that the data are not useful for the purpose intended; however, it is an indication that data precision should be considered for the overall assessment of the data quality and the potential impact on data applicability in meeting site characterization objectives.

If the RPD or ND criteria are exceeded, samples will be qualified. Field duplicates will be evaluated, but field samples will not be qualified based on their results. The MSD results outside of the control limits may not result in qualification of the data. An assessment of the entire analytical process, including the sample matrix, is conducted to determine if qualification is warranted.

The evaluation of precision based on duplicate RPD requires that both the sample and its duplicate have concentrations of the target radionuclide exceeding five times their MDC. This excludes many measurements because the samples contain nondetectable or low levels of the target radionuclide. However, the ND method may be used for evaluating duplicate data where the results are less than five times their MDCs. This is based on the measurement uncertainty associated with low-level results. The ND test is calculated using the following formula:

Normalized Difference = $S - D / \sqrt{(TPU_S)^2 + (TPU_D)^2}$

Where:

S = Sample Result
D = Duplicate Result
TPU = Total Propagated Uncertainty

TPUs = 2 sigma TPU of the sample
TPUd = 2 sigma TPU of the duplicate

The control limit for the normalized difference is -1.96 to 1.96, which represents a confidence level of 95 percent.

The criteria to evaluate analytical method performance for precision (Table 3-3) will be based on the analytical method-specific (e.g., gamma spectrometry) precision measurements. Analytical method-specific precision measurement is calculated by taking the number of analyses meeting the RPD or ND criteria, dividing that by the total number of analyses, and multiplying by 100. Each analytical method-specific precision measurement will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CAU 322 CADD.

6.2.4 Accuracy

Accuracy is a measure of the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that result from sampling and analytical operations. It is used to assess the performance of laboratory measurement processes as well as to evaluate individual groups of analyses (i.e., sample delivery groups).

Accuracy is determined by analyzing a reference material of known parameter concentration or by reanalyzing a sample to which a material of known concentration or amount of parameter has been added (spiked). The measure of accuracy is expressed as the percent recovery (%R) (NNSA/NV, 2002b). This is calculated by dividing the measured sample concentration by the true concentration and multiplying the quotient by 100.

6.2.4.1 Accuracy for Chemical Analyses

The %R criteria to be used for assessment of accuracy are the parameter-specific criteria listed in Table 3-3. Accuracy for chemical analyses will be evaluated based on results from three types of spiked samples: MS, LCS, and surrogates. Matrix spike samples are prepared by adding a known concentration of a target parameter to a specified amount of matrix sample for which an independent estimate of the target parameter concentration is available. Laboratory control samples are prepared by adding a known concentration of a target parameter to a "clean" sample matrix (does not contain the target parameter). Surrogate samples are prepared by adding known concentrations of specific organic compounds to each sample analyzed for organic analyses (including QC samples).

For organic analyses, laboratory control limits are used for evaluation of %R. They are reevaluated quarterly at the laboratory by monitoring the historical data and performance for each method. The acceptable control limits for inorganic analyses are established in the EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994a).

The %R parameter performance criteria for accuracy will be compared to %R results of spiked samples. This will be accomplished as part of the data validation process. Accuracy values for organic and inorganic analysis that are within the established control criteria indicate that analytical results for associated samples are valid. The %R values that are outside the criteria do not necessarily result in the qualification of analytical data. It is only one factor in making an overall judgment about the quality of the reported analytical results. Factors beyond the laboratory's control, such as sample matrix effects, can cause the measured values to be outside of the established criteria. Therefore, the entire sampling and analytical process must be evaluated when determining the quality of the analytical data provided.

The criteria to evaluate analytical method performance for accuracy (Table 3-3) will be based on the analytical method-specific (e.g., VOCs) accuracy measurements. The analytical method-specific accuracy measurement is calculated by taking the number of analyses meeting the %R criteria, dividing that by the total number of analyses, and multiplying by 100. Each analytical method-specific accuracy measurement will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CAU 322 CADD.

6.2.4.2 Accuracy for Radiochemical Analyses

Accuracy for radiochemical analyses will be evaluated based on results from LCS and MS samples. The LCS is prepared by adding a known concentration of the radionuclide being measured to a sample that does not contain radioactivity (i.e., distilled water). This sample is analyzed with the field samples using the same sample preparation, reagents, and analytical methods employed for the samples. One LCS is prepared with each batch of samples for analysis by a specific measurement.

The MS samples are prepared by adding a known concentration of a target parameter to a specified field sample with a measured concentration. The MS samples are analyzed to determine if the measurement accuracy is affected by the sample matrix. The MS samples are analyzed with sample batches when requested.

The %R criteria to be used for assessment of accuracy will be the control limits for radiochemical analyses listed in Table 3-3. These criteria will be used to assess qualification of data associated with each spiked sample. This will be accomplished as part of the data validation process. Accuracy values that are within the established control criteria indicate that analytical results for associated samples are valid.

The criteria to evaluate analytical method performance for accuracy (Table 3-3) will be assessed based on the analytical method-specific (e.g., gamma spectrometry) accuracy measurements. The analytical method-specific accuracy measurement is calculated by taking the number of analyses meeting the %R criteria, dividing that by the total number of analyses, and multiplying by 100. Each analytical method-specific accuracy performance will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CAU 322 CADD.

6.2.5 Representativeness

Representativeness is a qualitative evaluation of measurement system performance. It is the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition (EPA, 1987). Representativeness is assured by a carefully developed sampling strategy, collecting the specified number of samples from proper sampling locations, and analyzing them by the approved analytical methods. An evaluation of this qualitative criterion will be presented in the CAU 322 CADD.

6.2.6 Completeness

Completeness is a quantitative and qualitative evaluation of measurement system performance. The criterion for meeting completeness is defined as generating sufficient data of the appropriate quality to satisfy the data needs identified in the DQOs. The quantitative measurement to be used to evaluate completeness is presented in Table 3-3 and is based on the percentage of measurements made that are judged to be valid. Percent completeness is determined by dividing the total number of valid analyses by the total number of analyses required to meet DQO data needs and multiplying by 100. Problems that may affect completeness include the total number of samples sent to the laboratory but not analyzed due to problems with samples (e.g., broken bottles, insufficient quantity, insufficient preservation), samples that were collected and sent but never received by the laboratory, and rejected data. If these criteria are not achieved, the dataset will be assessed for potential impacts on meeting site characterization objectives.

The qualitative criterion for evaluation of measurement system performance is that sufficient data of the appropriate quality have been generated to satisfy the data needs identified in the DQOs. An evaluation of this qualitative criterion will be presented in the CAU 322 CADD.

6.2.7 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 1987). To ensure comparability, all samples will be subjected to the same sampling, handling, preparation, analysis, reporting, and validation criteria. Approved standard methods and procedures will also be used to analyze and report the data (e.g., Contract Laboratory Program [CLP] and/or CLP-like data packages). This approach ensures that the data from this project will be of acceptable quality to support the decisions and selection of corrective action alternatives. An evaluation of this qualitative criterion will be presented in the CAU 322 CADD.

6.2.8 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest (EPA, 2001). The evaluation criteria for this parameter will be that measurement sensitivity (detection limits) will be less than or equal to the corresponding PALs. If this criterion is not achieved, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives.

6.3 Radiological Survey Quality Assurance

Radiological surveys will be performed and data collected in accordance with approved standard operating procedures.

7.0 Duration and Records Availability

7.1 Duration

After the submittal of the CAIP to NDEP (FFACO milestone date of June 30, 2003), the following is a tentative schedule of activities (in calendar days):

- Day 0: Preparation for field work will begin.
- Day 181: The fieldwork, including sample collection activities, will commence. Samples will be shipped to meet laboratory holding times.
- Day 282: The field investigation will be completed.
- Day 352: The quality-assured laboratory analytical data will be available for NDEP review.
- The FFACO date for the CADD is January 31, 2004.

7.2 Records Availability

Historic information and documents referenced in this plan are retained in the NNSA/NSO project files in Las Vegas, Nevada, and can be obtained through written request to the NNSA/NSO Project Manager. This document is available in the DOE public reading facilities located in Las Vegas and Carson City, Nevada, or by contacting the appropriate DOE Project Manager. The NDEP maintains the official Administrative Record for all activities conducted under the auspices of the FFACO.

8.0 References

AEC, see U.S. Atomic Energy Commission.

ARL, see Air Resources Laboratory/Special Operations and Research Division.

ASTM, see American Society for Testing and Materials.

Adams, S.R., IT Corporation. 1998. Memorandum to R. McCall (Science Applications International Corporation) regarding methodology for determining action levels for CAU 407, the Roller Coaster RADSAFE Area, 16 June. Las Vegas, NV.

Air Resources Laboratory/Special Operations and Research Division. 2003. Rainier Mesa Precipitation Summary. As accessed at http://www.sord.nv.doe/gov/raingage/monthly/Buster_Jangle_Y_Monthly_data.txt on 7 April.

American Society for Testing and Materials. 1996. Sections 04.08 and 04.09, "Construction." In *Annual Book of ASTM Standards*. Philadelphia, PA.

BN, see Bechtel Nevada.

Bechtel Nevada. 1995. *Nevada Test Site Performance Objective Criteria for Certification of Nonradioactive Hazardous Waste*, Rev. 0, G-E11/96.01. Las Vegas, NV.

Bechtel Nevada. 2002a. Aerial photographs of CAU 322, October. Nellis Air Force Base, NV: Remote Sensing Laboratory Photo Library.

Bechtel Nevada. 2002b. NTS Facilities and Infrastructure Database. Las Vegas, NV.

CFR, see *Code of Federal Regulations.*

Code of Federal Regulations. 2001a. Title 40 CFR, "Protection of the Environment," Part 261, "Identification and Listing of Hazardous Waste." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2001b. Title 40 CFR, "Protection of the Environment," Part 262.34, "Standards Applicable to Generators of Hazardous Waste, Subpart C - Pre-Transport Requirements, Accumulation Time." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2001c. Title 49 CFR, "Shippers-General Requirements for Shipment and Packaging," Part 173. Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2002a. Title 40 CFR, "Protection of the Environment," Parts 260-282. Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2002b. Title 40 CFR, "Protection of the Environment," Part 761, "PCBs." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2002c. Title 40 CFR, "Protection of the Environment," Part 763, "Asbestos." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2002d. Title 29 CFR, "Occupational Safety and Health Administration, Department of Labor," Part 1926.1101, "Asbestos." Washington, DC: Government Printing Office.

DOE, see U.S. Department of Energy.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

Dinwiddie, G.A., and J.E. Weir, Jr. 1979. *Summary of Hydraulic Tests and Hydrologic Data for Holes UE16d and UE16f, Syncline Ridge Area, Nevada Test Site*. Prepared for USGS. Denver, CO.

EPA, see U.S. Environmental Protection Agency.

EG&G Rocky Flats. 1991. *General Radiochemistry and Routine Analytical Services Protocol (GRASP),* Version 2.1, July. Golden, CO.

FFACO, see *Federal Facility Agreement and Consent Order.*

Federal Facility Agreement and Consent Order. 1996 (as amended). Agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense.

Holmes & Narver, Inc. 1966. Engineering Drawing NV-35-82-01.1 entitled, "L.A.S.L. Post Shot Yard Floor Plan," As-Built, 12 January. Mercury, NV: Archives and Records Center.

Holmes & Narver, Inc. 1979. Engineering drawing entitled, "Area 3 Mud Plant," 1 April. Las Vegas, NV.

IT, see IT Corporation.

IT Corporation, 2000. CAU 322, CAS 03-20-05 File. "Contact Report Between B. Bordelois and C. Smith," 2 November. Las Vegas, NV.

IT Corporation. 2002. CAU 34, CAS 03-25-03, File. Las Vegas, NV.

Karathanasis, A.D., and B.F. Hajek. 1982. "Quantitative Evaluation of Water Adsorption on Soil Clays." In *Soil Science Society of America Journal*, 46: 1321-1325. Madison, WI.

LLNL, see Lawrence Livermore National Laboratory.

Lawrence Livermore National Laboratory. 1982. "The Geology of Yucca Flat." In *Energy and Technology Review*, April. Livermore, CA.

Lee, P.K. 1965. Health Physics Brief for EP IV of the Phoebus 321 Reactor, 1 July. Las Vegas, NV.

Madsen, D., Bechtel Nevada. 2000. Record of Telecon with J. Rose (ITLV) regarding CAS 03-25-03, 24 October. Las Vegas, NV: IT Corporation.

McArthur, R.D., and R.J. Miller, Jr. 1989. *Off-Site Radiation Exposure Review Project, Phase II Soil Program,* DOE/NV/10384-23. Las Vegas, NV: Desert Research Institute.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (Science Applications International Corporation) entitled, "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV.

NAC, see *Nevada Administrative Code.*

NBMG, see Nevada Bureau of Mines and Geology.

NDEP, see Nevada Division of Environmental Protection.

NNSA/NV, see U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office.

NRS, see *Nevada Revised Statutes.*

Nevada Administrative Code. 2002a. NAC 444.570 - 444.7499, "Solid Waste Disposal." Carson City, NV.

Nevada Administrative Code. 2002b. NAC 444.850 - 444.8746, "Disposal of Hazardous Waste." Carson City, NV.

Nevada Administrative Code. 2002c. NAC 444.940 - 444.9555, "Polychlorinated Biphenyls." Carson City, NV.

Nevada Administrative Code. 2002d. NAC 444.965 - 444.976, "Disposal of Asbestos." Carson City, NV.

Nevada Administrative Code. 2002e. NAC 445A.2272, "Contamination of Soil: Establishment of Action Levels." Carson City, NV.

Nevada Administrative Code. 2002f. NAC 459.9929, "Storage Tanks." Carson City, NV.

Nevada Bureau of Mines and Geology. 1998. *Mineral and Energy Resource Assessment of the Nellis Air Force Range*, Open-File Report 98-1. Reno, NV.

Nevada Division of Environmental Protection. 1995. *Mutual Consent Agreement Between the State of Nevada and the U.S. Department of Energy for the Storage of Low-Level Land Disposal Restricted Mixed Waste*, 7 June. Transmittal from P. Liebendorfer (NDEP) to D. Elle (DOE/NV). Carson City, NV.

Nevada Division of Environmental Protection. 1997a. *Class II Solid Waste Disposal Site for Municipal and Industrial Solid Waste, Area 23 of the NTS*, Permit SW 13 097 04. Carson City, NV.

Nevada Division of Environmental Protection. 1997b (as amended). *Class III Solid Waste Disposal Site for Hydrocarbon Burdened Soils, Area 6 of the NTS*, Permit SW 13 097 02. Carson City, NV.

Nevada Division of Environmental Protection. 1997c (as amended). *Class III Solid Waste Disposal Site; U10C, Area 9 of the NTS*, Permit SW 13 097 03. Carson City, NV.

Nevada Division of Environmental Protection. 1999. *State of Nevada Water Pollution Control General Permit*, No. GNEV93001. Carson City, NV.

Nevada Division of Environmental Protection. 2000. Hazardous Waste Management Facility Permit Number NEVHW009. Carson City, NV: Bureau of Waste Management.

Nevada Revised Statutes. 2001a. NRS 444.440 - 444.620, "Collection and Disposal of Solid Waste." Carson City, NV.

Nevada Revised Statutes. 2001b. NRS 459.400 - 459.600, "Disposal of Hazardous Waste." Carson City, NV.

PAI, see Paragon Analytics, Inc.

Paar, J.G., and D.R. Porterfield. 1997. *Evaluation of Radiochemical Data Usability,* April, ES/ER/MS-5. Oak Ridge, TN: Lockheed Martin Energy Systems, Inc.

Paragon Analytics, Inc. 1999. Standard Operating Procedures, 754/704. Fort Collins, CO.

REECo, see Reynolds Electrical & Engineering Co., Inc.

Reynolds Electrical & Engineering Co., Inc. 1977. Engineering drawing 3-MP-C2, "Mud Plant Modification, Plant Site, Civil Demolition Plan," 6 May. Mercury, NV: Archives and Records Center.

Reynolds Electrical & Engineering Co., Inc. 1994. *Spill Report Status*, 24 May. Las Vegas, NV.

Shaw Environmental, Inc. 2003. *Surface Geophysical Survey Final Report Corrective Action Units Nevada Test Site*, May. Las Vegas, NV.

Soil Science Society of America. 1986. *Methods of Soil Analysis*, 2nd Edition, Part 1. Madison, WI.

Stewart, J.D., U.S. Department of Energy, Nevada Operations Office. 1992. Memorandum to D.R. Elle (DOE/NV) entitled, "Transmittal of 45-Day Report for Two Diesel Fuel Releases at the Area 3 Mud Plant, Nevada Division Emergency Management (NDEM), Case Number H9202225C," 23 April. Mercury, NV.

USACE, see U.S. Army Corps. of Engineers.

USC, see *United States Code*.

USGS, see U.S. Geological Survey.

United States Code. 1976. 15 USC 2601 et seq., "Toxic Substances Control Act." Enacted by Public Law No. 94-469, as amended. Washington, DC: U.S. Government Printing Office.

U.S. Army Corps of Engineers. 1970. "Laboratory Soils Testing." In *Engineering Manual 1110-2-1906, Appendix II*. Washington, DC.

U.S. Department of Energy. 1988. *Environmental Survey Sampling and Analysis Plan,* 8 January. Washington, DC: Environment, Safety, and Health Office of Environmental Audit.

U.S. Department of Energy. 1997. *Manual of the Environmental Measurements Laboratory Procedures*, HASL-300, 28th Ed., Vol. I. New York, NY.

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002a. *Industrial Sites Quality Assurance Project Plan, Nevada Test Site, Nevada*, Rev. 3, DOE/NV--372. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002b. *Nevada Test Site Waste Acceptance Criteria*, DOE/NV--325, Rev. 4. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1994. *Project Management Plan*, Rev. 0. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1996. *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada,* DOE/EIS 0243. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1997. *Integrated Safety Management Policy*, DOE Order NV P 450.4. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1998. *Nevada Test Site Resource Management Plan*, DOE/NV--518. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1999. *RCRA Part B Permit Application for Waste Management Activities at the Nevada Test Site*. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000a. *Corrective Action Investigation Plan for Corrective Action Unit 262: Area 25 Septic Systems and Underground Discharge Point, Nevada Test Site, Nevada*, DOE/NV--629. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000b. *Nevada Test Site Contaminated Land Areas Report Volume I*, December. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000c. *Nevada Test Site Contaminated Land Areas Report Volume II,* December. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2000d. *NV/YMP Radiological Control Manual*, Rev. 4, DOE/NV/11718-079. Prepared by A.L. Gile of Bechtel Nevada. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2002. *Corrective Action Decision Document/Closure Report for Corrective Action Unit 34: Area 3 Contaminated Waste Sites, Nevada Test Site, Nevada*, Rev. 0, DOE/NV--811. Las Vegas, NV.

US Ecology and Atlan-Tech. 1991. *Environmental Monitoring Report for the Proposed Low-Level Radioactive Waste (LLRW) Facility, Ward Valley, California*. Auburn, CA.

U.S. Environmental Protection Agency. 1980. *Prescribed Procedures for Measurements of Radioactivity in Drinking Water*, EPA-600/4-80-032. Washington, DC.

U.S. Environmental Protection Agency. 1987. *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87/003. Washington, DC.

U.S. Environmental Protection Agency. 1988a. *Contract Laboratory Program Statement of Work for Inorganic Analysis*, SOW No. 788, EPA/540/R-94/093. Washington, DC.

U.S. Environmental Protection Agency. 1988b. *Contract Laboratory Program Statement of Work for Organic Analysis*, SOW No. 2/88, EPA/540/R-94/096. Washington, DC.

U.S. Environmental Protection Agency. 1991. *Contract Laboratory Program Statement of Work for Organic Analysis*, OLMO 1.8, EPA/540/R-94/078. Washington, DC.

U.S. Environmental Protection Agency. 1994a. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA/540/R-94/013. Washington, DC.

U.S. Environmental Protection Agency. 1994b. *Contract Laboratory Program Statement of Work for Inorganic Analysis*, ILMO 3.0, EPA/540/R-94/076. Washington, DC.

U.S. Environmental Protection Agency. 1994c. *Contract Laboratory Program Statement of Work for Organic Analysis*, OLMO 3.1, EPA/540/R-94/073. Washington, DC.

U.S. Environmental Protection Agency. 1995. *Contract Laboratory Program Statement of Work for Inorganic Analysis*, ILMO 4.0, EPA/540/R-95/121. Washington, DC.

U.S. Environmental Protection Agency. 1996. *Test Method for Evaluating Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition, CD-ROM PB97-501928GEI. Washington, DC.

U.S. Environmental Protection Agency. 1999. *Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA 540/R-99/008. Washington, DC.

U.S. Environmental Protection Agency. 2001. *Guidance on Data Quality Indicators,* EPA QA/g-5i. Washington, DC.

U.S. Environmental Protection Agency. 2002a. Integrated Risk Information System Web Page http:\\www.epa.gov\iriswebp\iris\index.html as accessed on 2 December.

U.S. Environmental Protection Agency. 2002b. *Region IX Preliminary Remediation Goals (PRGs)*. Prepared by S.J. Smucker. San Francisco, CA.

U.S. Geological Survey. 2002. "USGS/DOE Nevada Water Use Wells." As accessed at http://nevada.usgs.gov/doe-nv/wateruse on 7 February.

U.S. Nuclear Regulatory Commission. 1992. Licensing Requirements for Land Disposal of Radioactive Waste. Washington, DC: U.S. Government Printing Office.

van Genuchten, M. 1980. "A Closed Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils." In *Soil Science Society of America Journal,* 44:892-898. Madison, WI.

Winograd, I.J., and W. Thordarson. 1975. *Hydrogeologic and Hydrochemical Framework, South-Central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site,* USGS Professional Paper 712-C. Prepared on behalf of the U.S. Atomic Energy Commission. Washington, DC: U.S. Geological Survey.

Wuellner, J.W. 1994. Memo to J.P. Bielawski (REECo) entitled, "Historical Information – Area 3 Waste Mud Impoundment," 2 May. Las Vegas, NV.

Appendix A.1

Data Quality Objectives

A.1 Data Quality Objectives Process

The DQO process described in this appendix is a seven-step strategic planning approach based on the scientific method that was used to plan site characterization data collection activities at CAU 322: Areas 1 & 3 Release Sites and Injection Wells at the NTS, Nevada (Figure A.1-1). The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend corrective actions (i.e., no further action, closure in place, or clean closure). The existing information about the nature and extent of contamination at the three CASs in CAU 322 is insufficient to evaluate and select preferred corrective actions; therefore, a CAI will be conducted.

The CAU 322 investigation will be based on DQOs presented in this appendix as developed by representatives of the NDEP and the NNSA/NSO. The seven steps of the DQO process developed for CAU 322 and presented in Sections A.1.2 through A.1.8 were developed based on the CAS-specific information presented in Section A.1.1.

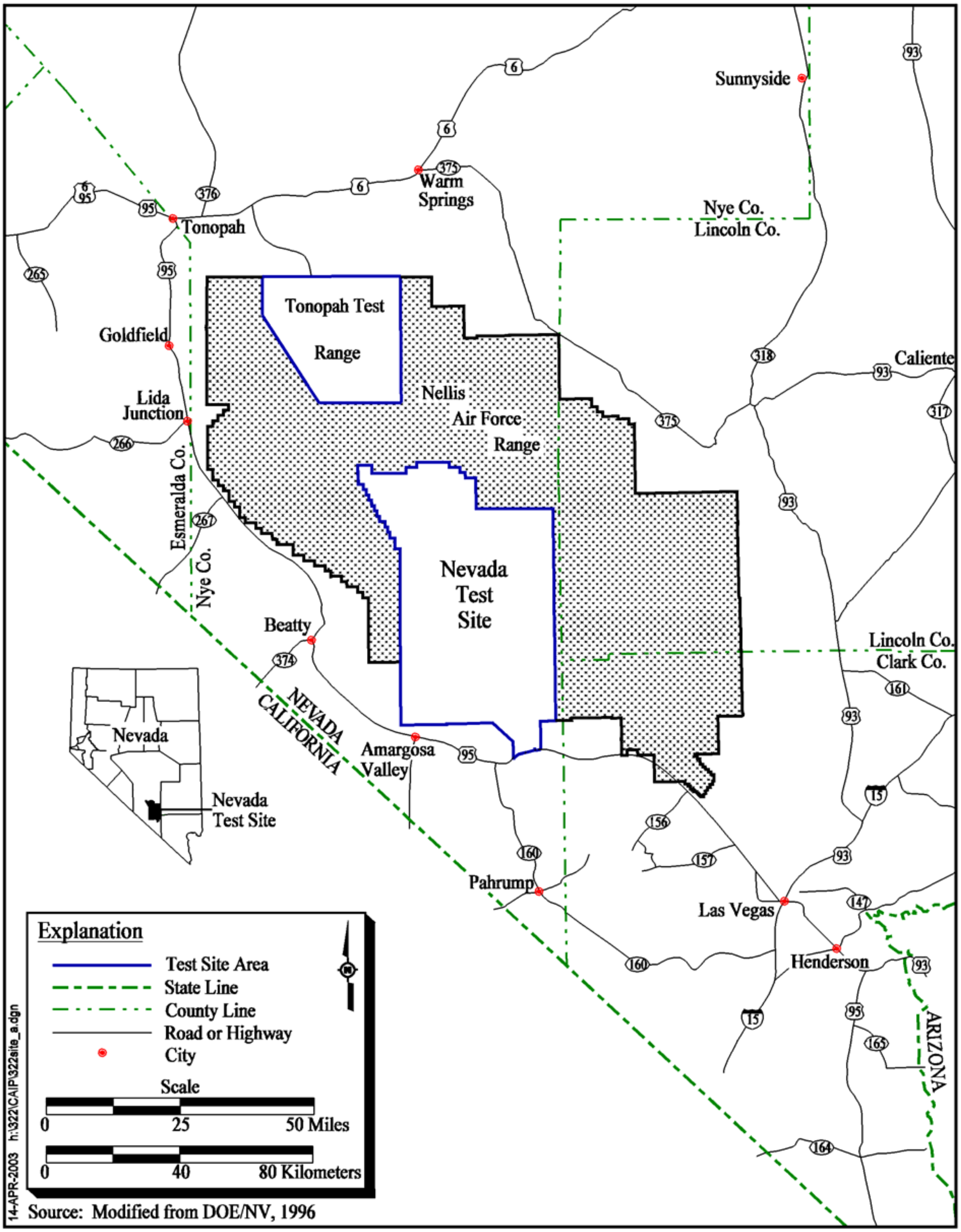
A.1.1 Corrective Action Site-Specific Information

Corrective Action Unit 322 consists of one CAS in Areas 1 and two CASs in Area 3 of the NTS as shown in Figure A.1-2. These CASs are:

- CAS 01-25-01 - AST Release - Area 1
- CAS 03-25-03 - Mud Plant AST Diesel Release - Area 3
- CAS 03-20-05 - Injection Wells - Area 3

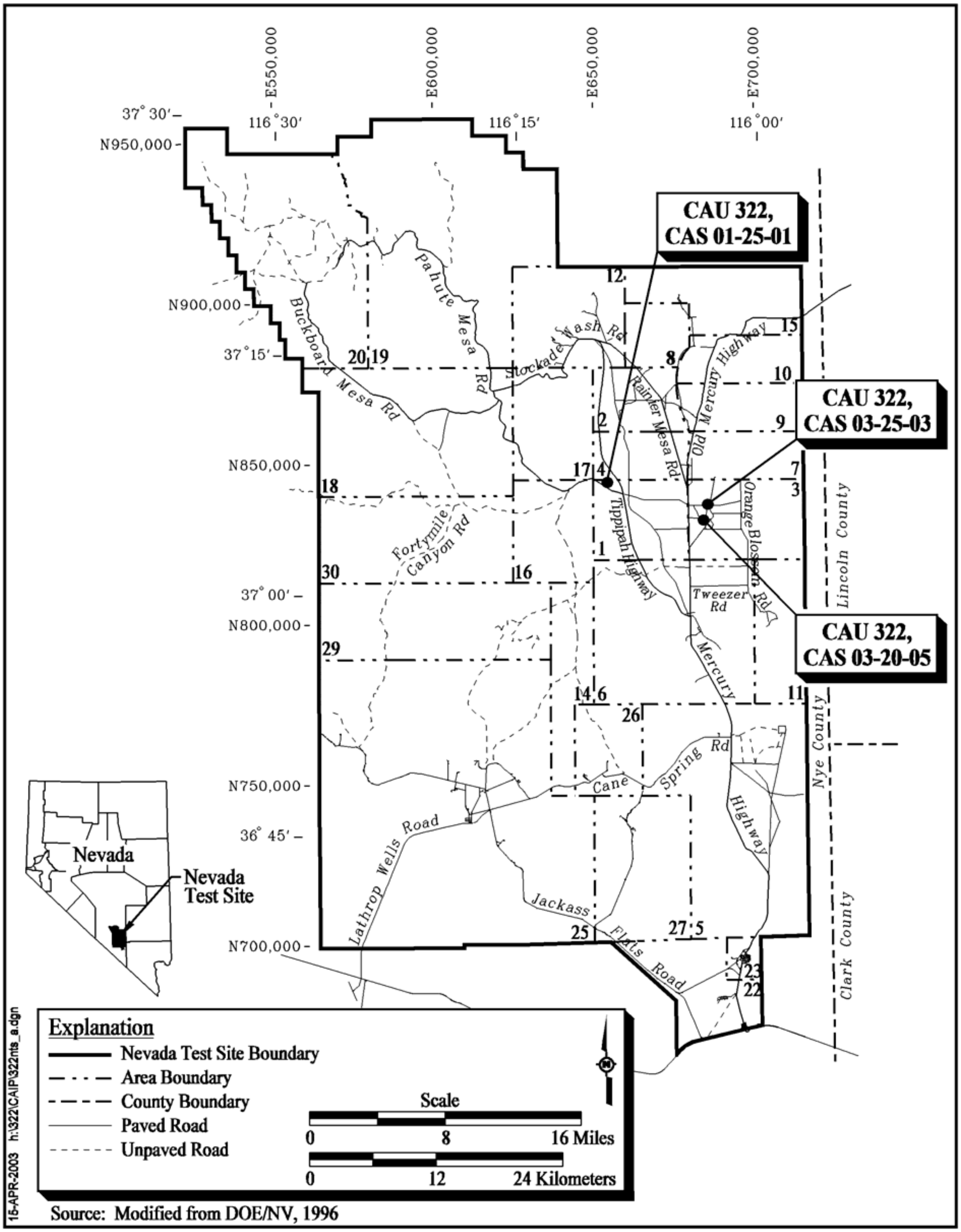
Suspected COPCs are divided into critical COPCs and noncritical COPCs, and the critical analyte parameters are given greater emphasis in the decision making process relative to other COPCs. For this reason, more stringent performance criteria are specified for critical parameter DQIs. Refer to Section 6.0 of the CAIP.

Suspected contaminants for each CAS are described in the following descriptions and listed in Table A.1-1. Critical COPCs are defined as those contaminants that are known or expected to be present within a CAS. Noncritical COPCs are defined as classes of contaminants (e.g., VOCs, TPH) and include all the parameters reported from the representative analytical methods that have PALs



Source: Modified from DOE/NV, 1996

Figure A.1-1
Nevada Test Site Location Map



Source: Modified from DOE/NV, 1996

Figure A.1-2
Corrective Action Unit 322 Location Map

Table A.1-1
Phase I Suspected CAS-Specific Contaminants of Potential Concern Per CAS[a]

COPC		CAS 01-25-01	CAS 03-25-03		CAS 03-20-05
			Area A, AST Release	Area B, Diesel Generator	
Organics					
VOCs		N	N	N	C
SVOCs		N	N	N	C
PCBs		N	N	N	C
TPH Petroleum Hydrocarbons [C_6 - C_{38}]	GR0	C	C	C	C
	DRO	C	C	C	C
Metals					
RCRA Metals			N	N	C
Beryllium			N	N	N
Radionuclides					
Americium-241[b]			N	N	C
Cesium-137[b]			N	N	C
Strontium-90[b]			N	N	C
Plutonium-238[b] and -239/240[b]			N	N	C
Uranium-234[b] ,-235[b], -238[b]			N	N	C
Tritium					C
Cobalt					C

[a] For those COPCs identified that include multiple parameters, the parameters with PALs will be evaluated.
[b] National Council on Radiation Protection and Measurements (NCRP) Report No. 129, "*Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies*." (NCRP, 1999)

C = Critical COPCs; N = Noncritical COPCs

Some radionuclides will be sampled for the purpose of waste management and IDW characterization. The table does not include identification of analysis anticipated to be performed for the purpose of waste management and IDW characterization.

listed in Section A.1.4.2. If a COPC is detected in any sample at a concentration above a PAL, the COPC will be identified as a COC. All COCs are considered critical parameters. If a COC is identified, the CAS containing the COC will be further investigated to determine the extent of COC contamination.

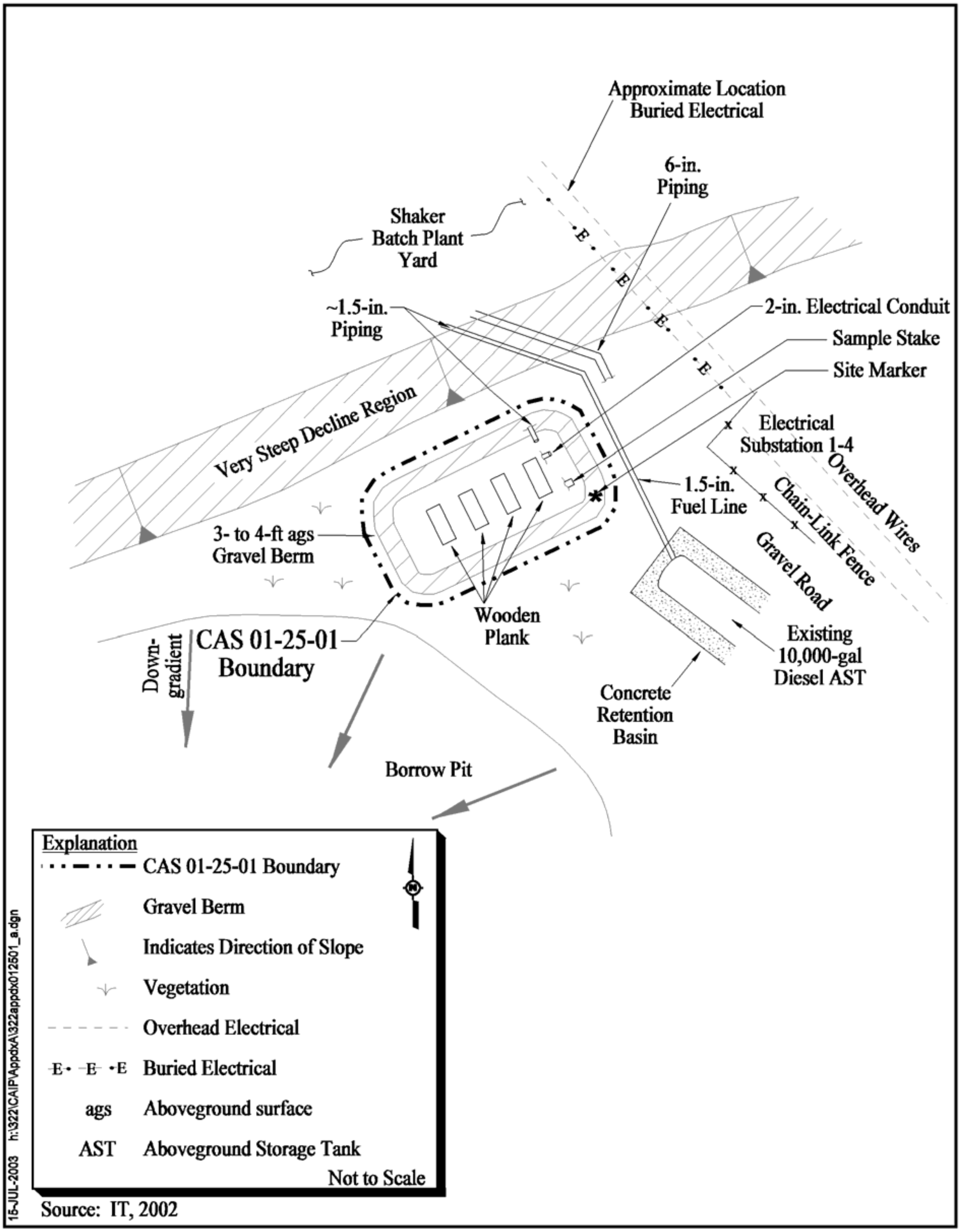
A.1.1.1 CAS 01-25-01, AST Release

Scope of CAS - The scope of the CAS consists of a gravel containment pit suspected to be the location of a former AST, as shown in Figure A.1-3. Contamination may be present at the surface, and possibly in the subsurface soil within the pit due to the past site use. The scope of this investigation will be to determine if contamination is present in the soil at the containment pit.

The determination of the nature and extent of possible contamination will be limited to releases from sources within the CAS boundary. There are no other CASs adjacent to CAS 01-25-01 that would interfere with the determination of the nature and extent of contamination. The investigation of radiological contamination will not be performed. However, analysis of samples for radionuclides may be performed for the purpose of waste management and IDW characterization. Radiological contamination associated with atmospheric testing, if present, will be addressed by the Soils Project.

Physical Setting and Operational History - CAS 01-25-01 is a 27- by 60-ft gravel containment pit located at the edge of a bluff overlooking the Area 1 Shaker Plant. The gravel containment pit is located approximately 25 ft north of Electrical Substation 1-4. Four wooden planks are set into the gravel at the bottom of the pit. An existing AST is located approximately 40 ft southeast of the CAS. In addition, a partially buried 1-1/2-in. steel fuel line is located approximately 15 ft northeast of the CAS. The fuel line appears to supply the Shaker Plant with diesel fuel (Figure A.1-3). The gravel structure was constructed as a containment pit for an AST. The tank had a capacity of 10,000 gal and was reported to store diesel fuel for the Shaker Plant.

An electrical conduit with wire leads was observed in the southern end of the gravel containment area. In addition, a portion of a steel pipe was observed protruding through the east berm. The pipe appears to be part of an abandoned fuel line. No historical information is available that identifies a release of petroleum product at the site. Evidence of staining (e.g., fuel oil) was not observed within



Source: IT, 2002

Figure A.1-3
CAS 01-25-01, Site Plan of AST Release

the CAS. A wooden sample marker stake (ERS 00179) was located in the northern portion of the gravel containment area.

Sources of Potential Contamination - Historical records indicated the 10,000-gal AST was relocated from the gravel containment pit to a concrete containment pit located nearby. The nearby AST has a capacity of 10,000 gal and is believed to be the relocated tank. The AST was used to store fuel oil (i.e., diesel) and serviced the Shaker Plant. No evidence of a spill (e.g., staining) was observed and available records did not contain information indicating a release of fuel oil occurred at the CAS. Although there are no documented releases, overfills and small spills may have released petroleum hydrocarbons to the soil within the CAS.

Previous Investigation Results - A soil sample was collected in 2002 from within the northern portion of the gravel containment area and analyzed for VOCs, SVOCs, PCBs, RCRA metals, and radionuclides. Acetone was detected at a concentration of 0.023 mg/kg, which is below the PAL. The PCB concentrations were below the detection level of 0.033 mg/kg, except for Aroclor-1248 at a concentration of 0.064 mg/kg. All reported radionuclides (Cs-137, gross alpha, gross beta, and potassium-40) results were within background levels. Results of the analyses for RCRA metals reported an arsenic concentration of 7.7 mg/kg, which exceeded the PAL of 2.7 mg/kg. Although the arsenic concentration exceeded the PAL, the reported level was considered representative of ambient conditions at the site (NBMG, 1998; Moore, 1999). The remaining parameters were within background levels.

Suspected Contaminants of Potential Concern - The critical COPCs identified for this CAS are TPH (DRO and GRO) based on available test results, process knowledge, interviews, and available records. The presence of acetone was identified in a preliminary sample analysis. However, the presence of acetone in the sample might have been the result of a laboratory artifact and not an indication of contamination; therefore, acetone will not be considered a critical COPC.

The noncritical COPCs identified below are based on test results and common NTS concerns:

- PCBs are considered a noncritical COPC; detection of Aroclor-1248 was slightly above the detection limit and may not be an indicator of a contaminant at the site.

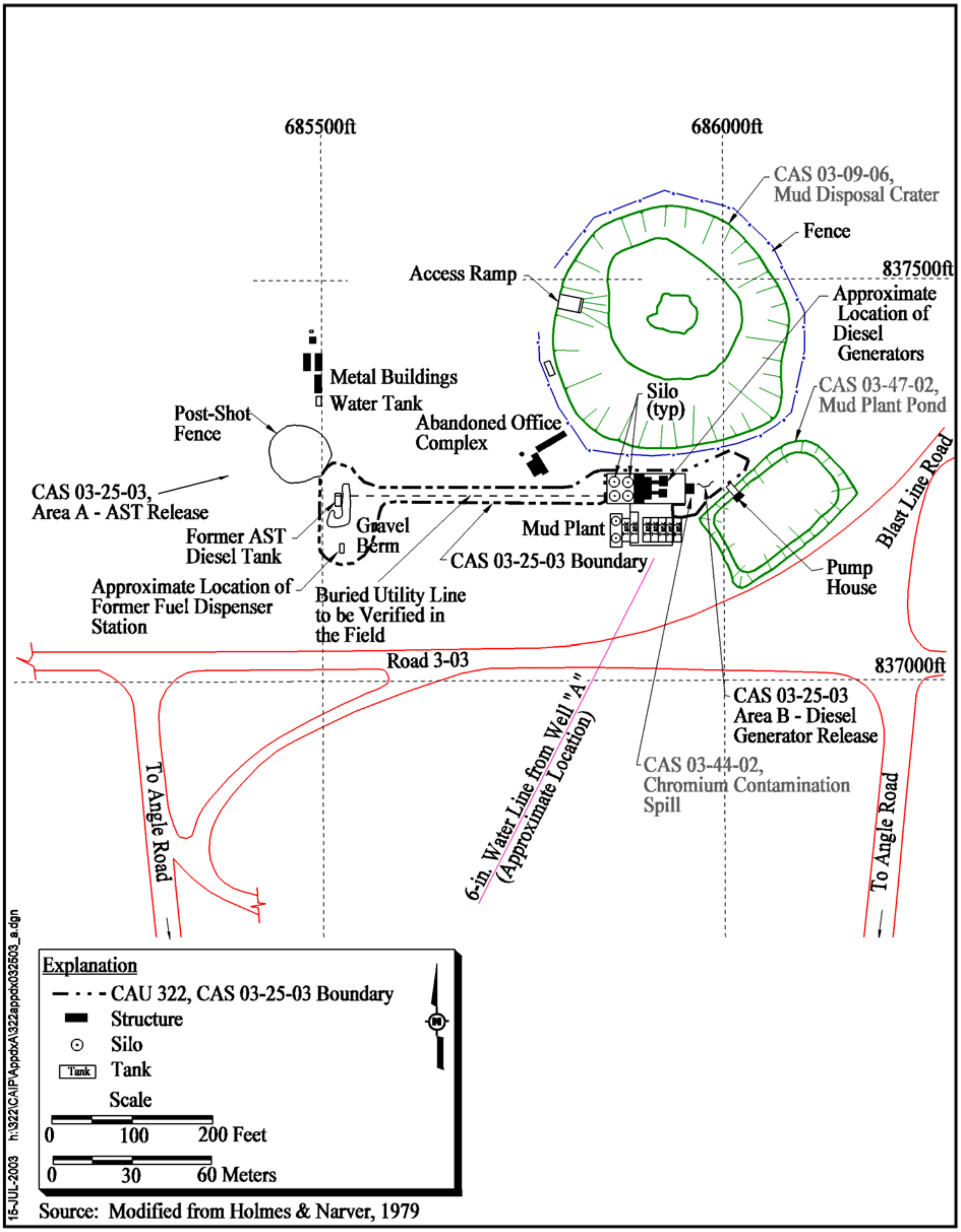
- VOCs and SVOCs are representative of general characteristics of fuel oil.

A.1.1.2 CAS 03-25-03, Mud Plant AST Diesel Release

***Scope of the CAS* -** The scope of the CAS 03-25-03 includes a fuel spill area consisting of a bermed gravel containment where a former diesel AST once resided. The scope also includes all affected soil following a speculative pathway proceeding east and downgradient towards the southeast side of the Mud Plant building (Figure A.1-4), and affected soil in a former roadway area located east of the Mud Plant building. In the eastern portion of the site, the boundaries of this CAS are adjacent to those of CAU 34: CASs 03-44-01, 03-09-06, and 03-47-02, although the extent of the impacted soil is uncertain.

The estimated CAS boundaries and footprint were established based on observations during the PA site visits, previous investigations, review of historical records, and aerial photographs. However, the boundary of this CAS may change based on the planned effort to define the nature and extent of suspected contamination. Sampling activities are expected to extend into the boundaries of neighboring areas of environmental concern (e.g., CAS 03-44-01 or another CAS). The investigation of radiological contamination, if necessary, will be limited to the sources associated with the CAS. Radiological contamination associated with atmospheric testing will be addressed by the Soils Project.

***Physical Setting and Operational History* -** This CAS is located in the former Area 3 Camp at the northwest corner of the intersection of Road 3-03 and Blast Line Road within the former Mud Plant compound (Figure A.1-4). The Mud Plant began operation in February 1962 and was used to formulate mud mixtures in support of drilling operations for the UGTA Program. Operation of the Mud Plant ceased in December 1995. An AST containing fuel oil and a fuel dispensing station were located approximately 350 ft west of the Mud Plant. Available records indicate the AST had a capacity of approximately 10,000 gal and was located in a gravel containment pit. Aerial photos indicate the fuel dispensing station was located south of the AST. Information was not available regarding the type of equipment or physical condition of the fuel dispensing station. The AST and fuel station were removed; however, the date of the removal was not available. Documentation indicated diesel generators were present in the eastern portion of the site. No information was available regarding when the generators were at the site.



Source: Modified from Holmes & Narver, 1979

Figure A.1-4
CAS 03-25-03, Site Plan of Mud Plant AST Diesel Release

***Sources of Potential Contamination* -** CAS 03-25-03 consists of three petroleum hydrocarbon releases at the former Mud Plant compound. Two of the reported releases occurred in the western portion of the complex referred to as Area A for this investigation and shown on Figure A.1-4. Available documents regarding the Area 3 Camp Mud Plant included information about a release of diesel fuel which occurred at the fuel dispensing station (Area A). The release occurred on February 20, 1992, during the unattended refueling of a service truck. The spill was assigned EPD Case Number 92A03-15 and approximately 50 to 100 gal of diesel fuel was reported to have been spilled. The spill was reported to the EPD on February 24, 1992 (REECo, 1994). Cleanup activities were undertaken following the notification and included the excavation of soil contaminated with diesel fuel oil and the collection of confirmation samples.

A second release of diesel fuel, also in Area A, was discovered during the cleanup of the initial fuel spill. Soil contaminated with fuel oil was observed as a result of a leaking buried valve on the fuel line connecting the AST and the fuel dispensing station. Approximately 8,100 cubic feet (ft^3) of soil was excavated as a result of the two diesel fuel releases. The fuel-contaminated soil was subsequently disposed of in the U-10C crater (Stewart, 1992).

The third hydrocarbon contamination area, within CAS 03-25-03, is located adjacent to the east wall of the Area 3 Camp Mud Plant building (Figure A.1-4 [Area B]). Contaminated soil was discovered when analytical results for CAU 34, CAS 03-44-02, were analyzed for petroleum hydrocarbons and results indicated TPH-DRO concentrations above the PAL of 100 mg/kg. The contamination is believed to be the result of diesel generators that were stored and/or operated in the study area. Sources of the contamination might have been overfilling or spills of diesel fuel during operation and refueling of the generators. Another alternative source of the contamination may have been fuel oil originating in the area of the western AST (Area A fuel spill) that migrated downgradient following buried utility lines to the east end of the building.

Radiological analysis may be required to satisfy health and safety planning needs and to support waste management decisions and IDW disposal. However, the radiological data are not intended to guide the identification and delineation of contamination within CAS 03-25-03. In addition, radiological contamination resulting from atmospheric testing is outside the scope of CAU 322.

Previous Investigation Results - The release of diesel fuel at the AST and fuel dispensing station exceeded the State of Nevada action level of 10 ft^3 of soil containing greater than 100 mg/kg TPH and 25 gal of a petroleum product released. Soil samples were collected at the time of the cleanup. A soil sample of the ground surface in the area of the fuel spill had a TPH concentration of 34,600 mg/kg. In addition, two soil samples were collected at a depth of 0.8 ft bgs and had TPH concentrations below the method detection limit of 10 mg/kg.

During the cleanup and excavation of contaminated soil resulting from the fuel spill, the second area of contaminated soil was discovered. Interview statements reported contaminated soil was excavated to a depth of between 10 to 16 ft. Two composite soil samples were collected from the side walls of the excavation. Results of the two sidewall tests were below the method detection limit. However, a bottom sample had a TPH concentration of 55,500 mg/kg.

The third reported area of contaminated soil within CAS 03-25-03 is located adjacent to the east side of the Mud Plant facility. The TPH contamination was detected during the investigation study for CAS 03-44-02, and analytical results indicated TPH (DRO) concentrations above the PAL of 100 mg/kg in 10 of 14 samples. The TPH concentrations in the soil ranged from 60 mg/kg, detected at a depth of 1 to 2 ft bgs, to 23,000 mg/kg detected at a depth of 6 to 7 ft bgs. In addition, samples were analyzed for total chromium, TCLP chromium, VOCs, SVOCs, and RCRA metals. The results of the sampling are presented below:

- VOCs were not detected in soil samples at concentrations exceeding the PALs (EPA, 2002b).
- SVOCs were not detected in soil samples at concentrations exceeding PALs (EPA, 2002b).
- Except for arsenic and chromium, all the total metal results were below PALs (DOE/NV, 2001; EPA, 2002b).
- Radionuclide analyses were at background levels.

The arsenic is considered to be within background levels based on the references presented previously. Chromium was detected at or above the PAL of 450 mg/kg in two soil samples from CAS 03-44-02. The chromium concentrations for the samples exceeding PALs were 530 mg/kg to 450 mg/kg. Additional TCLP chromium analyses were performed for three samples 0.12 mg/L, 0.59 mg/L, and 0.11 mg/L. The presence of chromium was addressed in the CAU 34 CADD/CR and is not addressed in this investigation.

Contaminants of Potential Concern - The critical COPCs identified for this CAS are TPH (DRO and GRO) based on available test results, process knowledge, interviews, and available records.

The noncritical COPCs identified below are based on test results and common NTS concerns:

- SVOCs representative of diesel fuel products
- PCBs, VOCs, RCRA metals, and beryllium are common concerns at the NTS and have not been ruled out based upon process knowledge.
- Radiological-contaminated materials may be present at the site due to prior activities associated with the handling of mud disposal at an adjacent CAS.

A.1.1.3 CAS 03-20-05, Injection Wells

Scope of CAS **-** CAS 03-20-05 includes the BOP Shop Building, three below grade holding tanks, and an injection well. The BOP Shop structure is located in the LANL Post-Shot Yard and is identified in the NTS Facilities and Infrastructure Database as Building 03-3C-02 (Post-Shot Shop). Markings on the side of the building indicated it is the LAPS Building. For the purpose of this document, the building will be referred to as the BOP Shop. (BN, 2002)

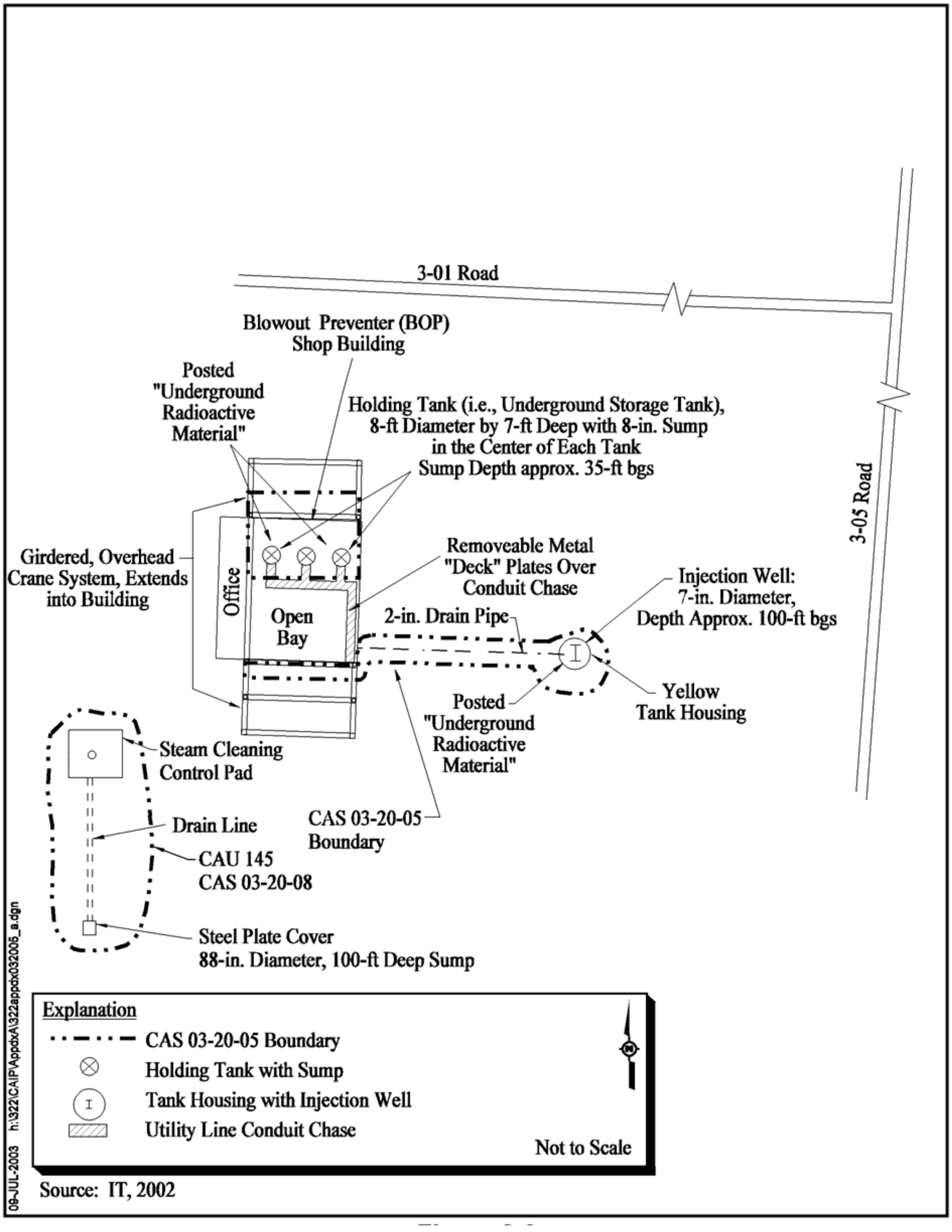
There are three below grade holding tanks located in the interior of the BOP Shop. While the three below grade tanks at the BOP Shop have historically been referred to as holding tanks, they meet the current definition of USTs (NAC 459.9929 [NAC, 2002b], which adopts the 40 CFR 280.12 definition [CFR, 2002]). This regulation states that USTs and their associated piping will be part of the UST system. Therefore, for the purpose of this investigation, the three holding tanks and associated piping described at CAS 03-20-05 will be treated as USTs.

An injection well is located to the east of the BOP Shop and consists of a below grade well vault and injection well. The design of the well vault and the injection well allowed for the separation of liquid phase product from discharged wastewater. As the level of the wastewater rose within the vault, the lighter separate phase product would discharge into the injection well and the remaining wastewater was allowed to infiltrate into the soil below the well vault. In this respect, the well vault resembled an oil/water separator and a dry well.

Soil contamination may be present at the surface and in subsurface soil due to the potential for a release, spill, or discharge of wastewater to the environment at the site. Existing data indicates previous operations at the site included the use of acids, oil, and petroleum hydrocarbon products, and solvents as part of the cleaning of blowout preventer equipment. In addition, the dry well and injection well received discharged wastewater from the holding tanks through a 2-in. buried drain line. Potential for soil contamination exists in the subsurface soil as a result of discharging wastewater into the injection well, dry well, and leakage of wastewater through the bottom of the well vault and sump. Additional sources of potential surface and near-surface soil contamination may have been caused by spillage of wastewater onto the BOP's concrete floor and runoff at the outside edge, and leakage from a buried 2-in. drain line.

The determination of nature and extent will be limited to releases from sources within the CAS boundary. The estimated site boundaries and footprint as identified in PA site visits, historical records, and aerial photographs are shown on Figure A.1-5. However, the boundary of this CAS may change based on the planned effort to define the nature and extent of suspected contamination. Sampling activities are not expected to extend into the boundaries of neighboring areas of environmental concern (e.g., CAU 145, CAS 03-20-08). The investigation of radiological contamination, if necessary, will be limited to the sources associated with the CAS. Radiological contamination associated with atmospheric testing will be addressed by the Soils Project.

***Physical Setting and Operational History* -** The BOP building is a two-story metal frame building with a concrete slab floor. Three below grade holding tanks (i.e., USTs) are located inside the northern end of the building. An office and mezzanine occupied the western side of the building. Bathroom facilities were not observed or documented in the PA information. The top of each holding tank is open and flush with the floor. Each tank has a diameter of approximately 8 ft and depth of about 7 ft. Below each tank is a sump constructed of steel casing. The walls of the tanks are steel and the bottom of the tanks are concrete. It is believed that each sump is about 8-in. diameter and 35-ft deep and is an integrated/closed unit with the holding tank. The sumps were constructed on a steel casing and reported to be sealed. The PA documentation indicated two of the tanks (eastern and



Source: IT, 2002

Figure A.1-5
CAS 03-20-05, Site Map Injection Wells

western) were used in the cleaning and servicing of the blowout equipment. The center tank was not used in the servicing of the blowout equipment. Two of the tanks are posted, "Underground Radioactive Material," and all three are covered with circular steel plates.

An injection well is located about 50 ft east of the BOP building and adjacent to the demolished Linesman Shop. The injection well is housed within a circular, below ground well vault structure. Documentation indicated the bottom of the well vault was crushed stone. A 2-in. drain line enters the well vault from the west (direction toward the BOP building). The well vault and injection well are covered by an aboveground steel protective shelter approximately 7 ft in diameter with a height of about 3-1/24 ft. Access to the interior of the shelter is limited. The shelter is painted yellow and has a posted warning that reads, "Underground Radioactive Material," and is surrounded by an orange, high-visibility fence (Figure A.1-5).

Documentation indicated the injection well has a casing diameter of approximately 7-in. and depth of about 100 ft bgs. Photographs of the interior of the shelter revealed a circular well vault (depth not available) and the well casing extended above the bottom of the vault. A residual material of an undetermined nature covered the bottom of the vault. Documentation about the construction of the well vault (e.g., concrete sides) was not available. The 2-in. diameter pipe, which enters the vault from the west side, is believed to be the drain from the holding tanks. The casing of the injection well extends above the bottom of the well vault, and the invert of the 2-in. drain appears to range between 6- to 8-in. below the top of the injection well casing.

The well vault appeared to have contained liquids (e.g., wastewater) based on the appearance of a stain along the inside wall of the vault. In addition, the raised position of the well casing would have allowed the well vault and injection well to perform as an oil/water separator. A rise of the wastewater level within the vault would have allowed floating material and separate phase product, if any, to drain into the well and allow the remaining wastewater to infiltrate the soil beneath the vault (i.e., the vault is a dry well).

Documentation revealed the sump casing within each holding tank extends above the bottom of the tank floor (24 in.) and is fitted with a flanged end. Interview information indicated blowout preventer equipment was bolted to the flange and cleaned using air pressure and water mixed with a variety of chemicals (e.g., acid, hydraulic oil, solvents). Wastewater was stored in the holding tanks during the cleaning operations and discharged periodically to the injection well (IT, 2002).

Based on interview information, the holding tank and the sump were a closed system and sealed to prevent leakage of cleaning fluid into the surrounding subsurface. Documentation also indicated the operation for cleaning and testing of the blowout preventer equipment was performed in the two outer tanks at the site and the center tank was empty.

In addition, documented interviews with former plant operators revealed the injection well became clogged with waste material and subsequent discharges of wastewater were pumped to a concrete decontamination pad located west of the BOP building. The scope of CAU 145, CAS 03-20-08 (currently pending preliminary assessment), includes the evaluation of the discharge of wastewater at the decontamination pad.

The facilities were deactivated and decommissioned in December 1989 and are currently inactive.

***Sources of Potential Contamination* -** Information indicates the wastewater liquid from the BOP holding tanks contained water, solvents, lubricating oils, oil and grease, and possibly radionuclides. The estimated monthly discharge was about 20 gal per month based on information from interviews with former employees (IT, 2002). The discharge of wastewater into the well vault and injection well potentially contaminated the underlying subsurface soil and groundwater around and beneath the well vault and the injection well. Other potential sources of contamination include runoff of wastewater from the building floor to the soil along the front and rear of the BOP building. In addition, a possible release of contaminated wastewater might have occurred into the underlying soil if the buried 2-in. drain pipe had a leak or a possible disconnect.

Radiological analysis is anticipated to be performed on the floor of the building, the interior of the holding tanks, and the interior of the well vault. In addition, radiological analysis may be required to satisfy health and safety planning needs and to support waste management decisions and IDW disposal. Radiological contamination associated with atmospheric testing is outside the scope of CAU 322.

Previous Investigation Results - Preliminary sampling and analysis was conducted by BN in 2001 on samples of liquid, soil, and sludge from within the holding tanks, well vault, and injection well to determine the concentration of VOCs, SVOCs, TPH, total metals, and radionuclides.

- VOCs were not detected in soil and liquid samples at concentrations exceeding the PALs (EPA, 2002b).
- SVOCs were detected in liquid samples at concentrations exceeding PALs (EPA, 2002b).
- TPH was detected in soil and sludge samples at concentrations exceeding PALs (EPA, 2002b).
- Radionuclide data was not available.

Except for arsenic, all the total RCRA metal results were below PALs (EPA, 2002b).

Contaminants of Potential Concern - The following critical COPCs identified for this CAS are based on prior test results, interviews, and process knowledge:

- TPH (DRO and GRO), hydraulic oil, and oil and grease from the servicing and decontamination of equipment
- VOCs: Chlorobenzene, isopropylbenzene, n-propylbenzene; 1,2,4-trimethylbenzene; 1,2-dichlorobenzene; 1,3,5-trimethylbenzene; o-xylene; chloroform, choroethane; chloromethane
- SVOCs: 4-methylphenol, bis (2-ethylhexyl) phthalate, and naphthalene
- Radionuclides: Cs-137; Sr-90; and Pu-238, -239/240; Am-241; and U-234, -235 from the posted radioactive warning signs and process knowledge for the decontamination of drilling equipment
- RCRA metals: Arsenic
- Polychlorinated biphenyls are common concerns at the NTS and have not been ruled out based upon process knowledge

Similarly, the noncritical COPCs identified below are based on interviews, common NTS concerns, and process knowledge:

- The remaining VOCs and SVOCs in the target compound list (TCL) and metals are representative of the constituents in the waste liquid and decontamination of drilling equipment.

A.1.2 Seven-Step DQO Process

This section presents the seven-step DQO process for an investigation as applied to CAU 322.

A.1.2.1 Step 1 – State the Problem

This step identifies the DQO planning team members, describes the problem that has initiated the CAU 322 site investigation, and develops the CSMs.

A.1.2.2 Planning Team Members

The DQO planning team consists of representatives from NDEP; NNSA/NSO; Shaw Environmental, Inc. (Shaw); and BN. The primary decision-makers include NDEP and NNSA/NSO representatives. Table A.1-2 lists representatives from each organization in attendance at the DQO meeting on February 10, 2003.

Table A.1-2
DQO Meeting Participants

Participant	Affiliation	Function
Syl Hersh	Shaw	Quality Processes Representative
Sabine Curtis	NNSA/NSO	Environmental Restoration Division Task Manager
Amber Steed	Shaw	Preliminary Assessments Liaison
Dudley Emer	BN	Task Manager
Lynn Kidman	Shaw	IS Task Manager
George Petersen	Shaw	IS CAU Lead
Charlotte Franky	Shaw	Environmental Compliance and Waste Management Lead
Steve Mergenmeier	Shaw	Quality Processes Representative
Gregory Raab	NDEP	Oversight/Representative

BN - Bechtel Nevada
IS - Industrial Sites
Shaw - Shaw Environmental, Inc.
NDEP - Nevada Division of Environmental Protection
NNSA/NSO - U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office

A.1.2.3 Describe the Problem

Corrective Action Unit 322 is being investigated because:

- Oil, grease, hazardous and/or radioactive constituents may be present at concentrations and locations that could potentially pose a threat to human health and the environment.
- Disposed waste may be present without appropriate controls (i.e., use restrictions, adequate cover).
- Effluent discharges into the dry well and injection wells potentially contaminated the soil surrounding the discharge structures and possibly groundwater.

As a result of the above activities, hazardous and/or radioactive constituents may be present at these CASs at concentrations that could pose a potential threat to human health and the environment. The problem statement for CAU 322 is, "Existing information as to the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives."

A.1.2.4 Develop Conceptual Site Model

Two CSMs have been developed for CAU 322 using assumptions formulated from the physical setting, potential contaminant sources and release information, and historical background information. The applicability of the following CSMs to each CAS is summarized in Table A.1-3 and discussed in the following sections.

The CSMs describe the most probable scenarios for current conditions at specific sites and define the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. They set the stage for assessing how contaminants could reach receptors both in the present and future by addressing contaminant nature and extent, transport mechanisms and pathways, potential receptors, and potential exposures to receptors. An accurate CSM is important because it serves as the basis for all subsequent inputs and decisions throughout the DQO process.

The CSMs are termed:

- Surface/Near-Surface, CSM #1
- Deep Injection, CSM #2

Section A.1.2.4.1 and Section A.1.2.4.2 develop and discuss these two CSMs, respectively.

Table A.1-3
Conceptual Site Models and Applicable CASs

Conceptual Site Models	01-25-01	03-25-03	03-20-05
Surface/Near-Surface	AST and possible buried distribution piping	AST and fuel dispenser, diesel generator, and buried distribution piping	Spill/run-off from floor slab; buried distribution piping and leakage of holding tanks
Deep Injection	----	----	Subsurface holding tank sumps and injection wells

An important element of a CSM is the expected fate and transport of contaminants, which infer how contaminants move through site media and where they can be expected in the environment. The expected fate and transport is based on distinguishing physical characteristics of the contaminants and media. Contaminant characteristics include solubility, density, particle size, and affinity to nonmobile particles. Media characteristics include permeability, saturation, sorting, chemical composition, adsorption coefficients, porosity, and hydraulic conductivity. In general, contaminants with low solubility and high density can be expected to be found relatively close to release points. Contaminants with high solubility and low density can be expected to be found further from release points or in areas where settling may occur.

Vapor phase diffusion is limited by the vapor pressure of the contaminant and is expected to be limited to relatively short distances from the contaminant source. Migration attributed to each of these driving forces under conditions found at the NTS would result in contaminant concentrations that decrease with distance from the contaminant source.

A.1.2.4.1 Surface/Near-Surface, Conceptual Site Model #1

The Surface/Near-Surface CSM #1 applies to the release of fuel oil at the ASTs, fuel dispensing station, and near-surface fuel contamination at CASs 01-25-01 and 03-25-03. For illustrative purposes, surface and near-surface discharge mechanisms at CAS 03-20-05 are presented in CSM #2. The possible spillage of wastewater potentially caused runoff across the BOP Shop floor slab. Surface spillage and the discharge of wastewater to the well vault potentially caused a release of contaminants to the soil.

Upon release from the source, the fuel product and/or wastewater is anticipated to have spread over the ground surface and infiltrated into the ground affecting the surface and shallow subsurface soil. For the near-surface release, the products infiltrated directly into the surface soil surrounding the release point and into the nearby soil. Figure A.1-6 shows a generalized representation of the Surface/Near-Surface CSM #1. The following discussion of the CSM #1 parameters provide additional details to supplement this model.

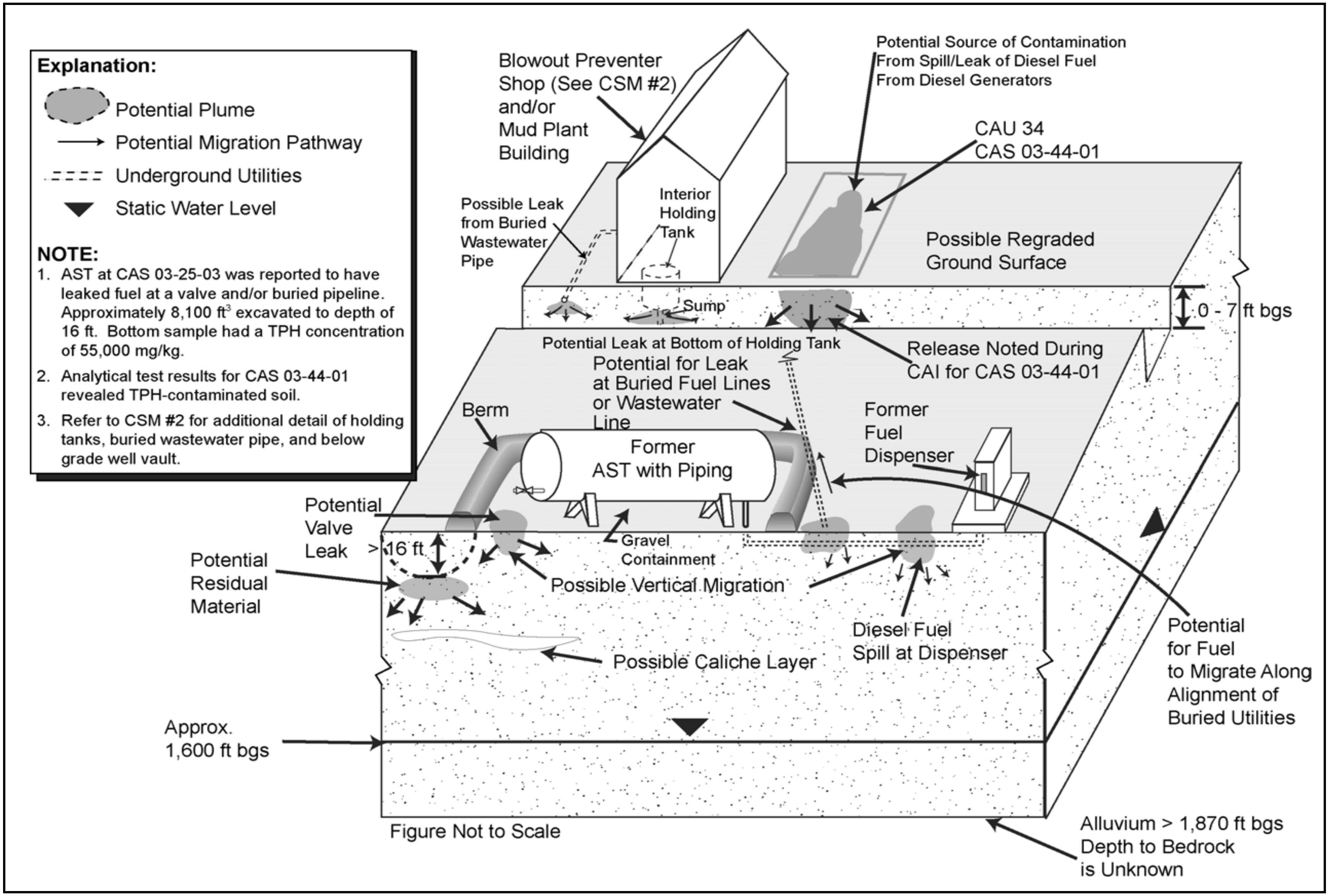
Exposure Scenario **-** The land-use designation for CASs 01-25-01 and 03-25-03 is within the Nuclear and High Explosive Test Zone for additional underground nuclear weapons tests and outdoor high-explosive tests. Based on the land-use designations, the potential for exposure to contaminants is limited to construction and industrial workers who may be exposed to COPCs through inadvertent oral ingestion, inhalation, or dermal contract (absorption) of soils and/or debris during excavation or other activities that would distribute the potentially contaminated soils.

Affected Media **-** The potentially affected medium is the surface and shallow subsurface soil beneath the former AST and associated underground piping, and surface soil throughout the CASs.

Location of Contamination/Release Points - The highest concentrations of contamination are expected to be beneath the outlet and piping connection of the AST and any breaches in the associated buried piping, in the area of the former fuel dispenser station, and in the area of the former diesel generators. Migration of contamination would be expected to be primarily downward with horizontal migration to a lesser extent.

Transport Mechanisms **-** Infiltration and percolation of liquid fuel and precipitation through soil serve as driving forces for downward migration.

Preferential Pathways - Preferential pathways for contaminant migration at CASs 01-25-01, 03-25-03, and 03-20-05 (for surface spills) are anticipated to be vertically into the soil. The presence of relatively impermeable layers (e.g., caliche layers, buried utilities) could modify transport pathways both on the ground surface and in the subsurface. At CASs 01-25-01 and 03-25-03, small gullies, ground-surface grading, and buried utilities, if present, could channel runoff and increase lateral transport prior to infiltration. Contamination could travel laterally to a small degree under all three scenarios, prior to infiltration. Although the preferential pathways for contaminant migration



Explanation:

Potential Plume

→ Potential Migration Pathway

- - - - Underground Utilities

▼ Static Water Level

NOTE:

1. AST at CAS 03-25-03 was reported to have leaked fuel at a valve and/or buried pipeline. Approximately 8,100 ft^3 excavated to depth of 16 ft. Bottom sample had a TPH concentration of 55,000 mg/kg.
2. Analytical test results for CAS 03-44-01 revealed TPH-contaminated soil.
3. Refer to CSM #2 for additional detail of holding tanks, buried wastewater pipe, and below grade well vault.

Figure A.1-6
Surface/Near-Surface Conceptual Site Model #1 for CAU 322, CASs 03-25-03 and 01-25-01

will be considered in the development of sampling schemes and sampling contingencies discussed in the CAIP, primary consideration will be given to the release mechanisms.

***Lateral and Vertical Extent of Contamination* -** The degree of contaminant migration, if any, at these sites is unknown, but it is assumed to be minimal based on the ambient environmental conditions at the NTS such as low precipitation (i.e., 3 to 10 in. per year), high evapotranspiration, and the limited mobility of COPCs (USGS, 1975). If contamination is present, it is expected to be limited to the surface and shallow subsurface at the site. Concentrations of contamination are expected to decrease with depth and distance from release points. Migration of contamination for release scenarios would be expected to be primarily downward, with horizontal migration to a lesser extent. Surface migration may occur as a result of storm events when precipitation rates exceed infiltration (stormwater runoff). However, these events are infrequent. Surface migration is a biasing factor considered in the selection of sampling points. As stated previously, downward contamination transport is expected to be very limited but is unknown because the quantities of hazardous material released is unknown.

Infiltration and percolation of precipitation through subsurface media and vapor phase diffusion serve as the major driving forces for migration of contaminants. However, due to the arid environment, the magnitude of infiltration and percolation of precipitation at the NTS is very small and migration of contaminants has been shown to be very limited. Evapotranspiration and arid environment greatly exceeds the infiltration of precipitation. The annual potential evaporation rate ranges from 60 to 82 in. per year, or roughly 5 to 25 times the annual precipitation. (USGS, 1975).

Groundwater contamination is not considered a likely scenario at CAU 322, due to minimal precipitation, high evapotranspiration, strong attenuation of suspected contaminants in the soil, and significant depths to groundwater. For example, the depth to groundwater at Area 1 is approximately 750 ft bgs at CAS 01-25-10, as measured in UE-16d Eleana Water Well located approximately 1-1/2 mi west of the site. The regional water table is assumed to be at about 1,600 ft bgs in Area 3 at CAS 03-25-03, as measured in U.S. Geological Survey (USGS) Water Well A located southeast of CAS 03-20-03 (USGS, 2002).

In addition, contaminants migrating to regional aquifers are not considered a likely scenario at CAU 322 due to the low mobility of expected COPCs (e.g., SVOCs, petroleum hydrocarbons, metals).

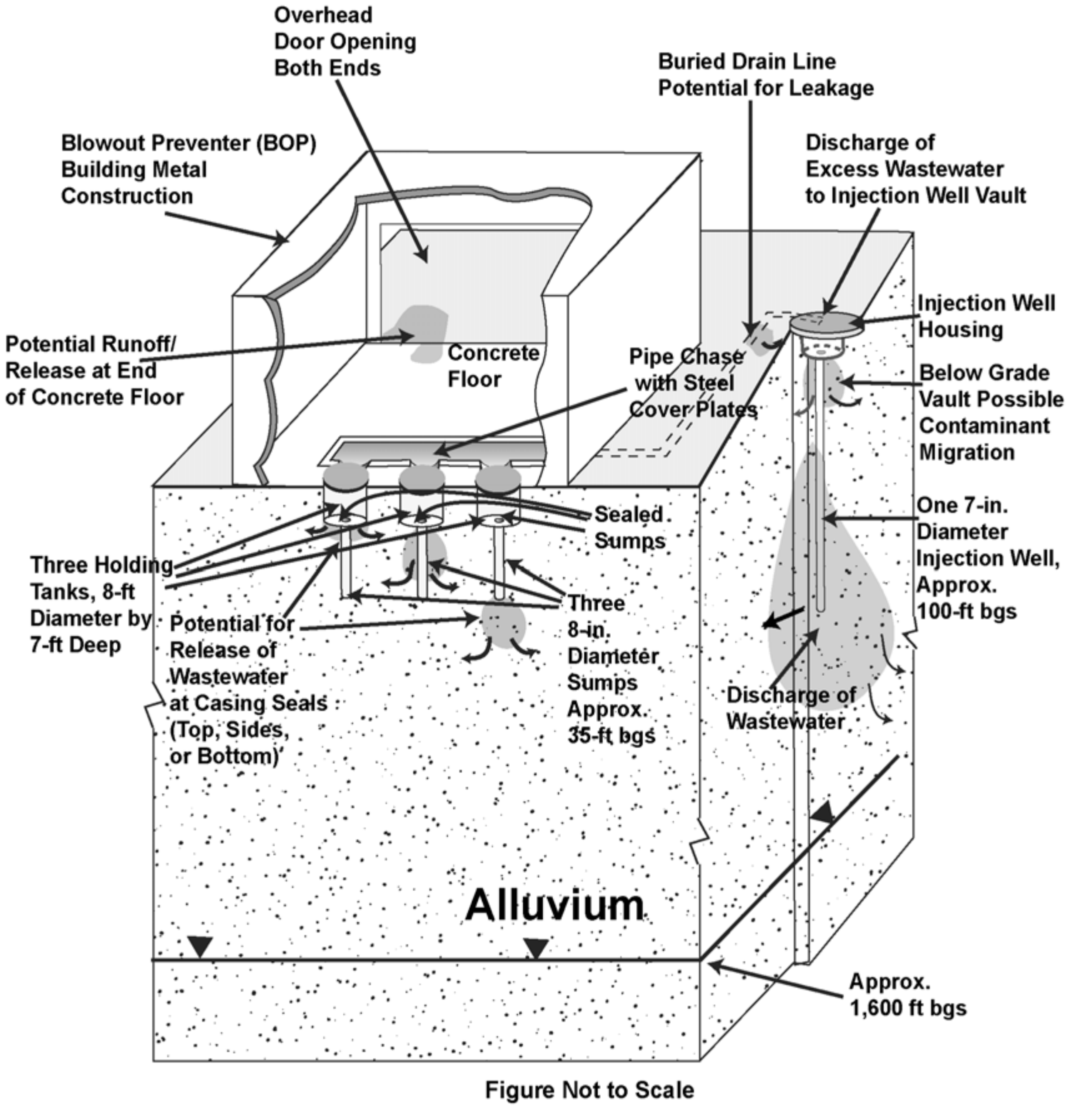
A.1.2.4.2 Deep Injection, Conceptual Site Model #2

Discharges of wastewater and potential hazardous materials to the well vault and in an unpermitted injection well are creating probable soil contamination and the potential for groundwater contamination. Wastewater discharges into the wells may be causing contaminants to build up in subsurface soil.

The Deep Injection CSM #2 applies to CAS 03-20-05. Effluent wastewater was discharged into the dry well and into deep injection wells. The bottom of the dry well was reported to be gravel stone covered with an oily residue. The bottom of the well vault is not known; however, it is expected to be less than 10 ft bgs. The injection well is expected to be 100 ft bgs with a screened casing forming the bottom portion of the well. The screen casing would allow for the infiltration and percolation of the wastewater into the subsurface soil. The length of the screened portion is not known. Figure A.1-7 shows a general representation of the Deep Injection CSM #2.

***Exposure Scenario* -** The land-use designation for CAS 03-20-05 is within the Nuclear and High Explosives Test Zone for additional underground nuclear weapons tests and outdoor high-explosive tests. Based on this land-use designation, the potential for exposure to contaminants is limited to construction and industrial workers who may be exposed to COPCs through inadvertent oral ingestion, inhalation, or dermal contract (absorption) of soils and/or debris during excavation or other activities that would distribute the potentially contaminated soils.

***Affected Media* -** Subsurface soil surrounding and beneath the base of the injection wells. Although the depth of this well (approximately 100 ft) is well above the regional water table (approximately 1,600 ft bgs), the potential for groundwater contamination exists from repeated discharge at these point source locations. This potential for groundwater contamination is greater from subsurface release rather than for discharges directly to the land surface because vertical movement of contaminated water released into the subsurface will not be affected by evaporation and the continued release would tend to push the contamination deeper into the subsurface.



Explanation:

- ▨ Potential Plume
- → Potential Migration Pathway
- = = = = Underground Pipe
- ▼ Static Water Level

NOTE:

1. Holding tanks and sumps are a closed system. Sump casing about 8-in. inside diameter and depth of 35 ft.
2. Casing flange of sump designed to support blowout preventor during cleaning.
3. Wastewater from the holding tanks pumped to the injection well through a 2-in. pipe.
4. Bedrock at depth of greater than 1,870 ft bgs based on boring log of USGS Well A located approximately 400 ft northeast of CAS.
5. Two of the holding tanks (i.e., center and east side) contained wastewater on date of site visit (Jan. 9, 2003.)
6. All three holding tanks were covered with steel plates.

▨ **Alluvium**

Figure A.1-7
Deep Injection Conceptual Site Model #2 for CAU 322, CAS 03-20-05

In addition to the potential release of contaminants through the injection wells, if the tanks leaked or fluid spilled, contamination would have been released onto the concrete floor to the building and then flowed onto the adjacent soil outside of the building.

***Location of Contamination/Release Points* -** The injection well is believed to have multiple release points through a screened casing. If present, soluble contaminants are expected throughout the length of the injection well with large particle contaminants expected at the lower portions of the injection wells. In addition, contaminant release might have occurred (1) at the edges of the concrete slab surrounding the three holding tanks, (2) within the steel housing of the external injection well, and (3) beneath any breaches in the buried drain lines.

***Transport Mechanisms* -** The injection of wastewater into the injection wells was the primary transport mechanism. Infiltration and percolation through soil is a secondary mechanism that moves contaminants deeper into the soil. Prior to sealing the wells beneath the holding tanks, liquid waste in the tanks served as a continuing source of contamination.

***Preferential Pathways* -** Preferential pathways for contaminant migration continues to be a downward movement of contaminants through the gravel-filled injection wells and any potential surface runoff from the concrete pad of the building. Contaminants would be expected to migrate away from the release point, primarily downward and, to a lesser degree, horizontally.

***Lateral and Vertical Extent of Contamination* -** The degree of contamination migration at the dry wells are unknown, but is assumed to be greatest at near the bottom of the wells. Percolation of contaminants at the surface is assumed to be minimal because of low precipitation (i.e., 3 to 10 in. per year), high evapotranspiration, and the mobility of COPCs (USGS, 1975). Any contamination in the injection wells is anticipated to be contiguous with contamination increasing with depth and decreasing with distance from the release point.

A.1.3 Step 2 - Identify the Decision

This step is to identify the decision that requires new environmental data to address each CAS's potential contamination problem. It identifies decisions and alternative actions needed for performing an effective Phase 1 and possibly Phase II investigation(s).

A.1.3.1 Develop a Decision Statement

The primary problem statement is, “Insufficient amount of information available concerning the nature and extent of contamination potentially released at CASs to determine if there is an unacceptable risk to human health and the environment.” Because existing information at these CASs is insufficient to resolve the problem statement, the following two decision statements have been established as criteria for determining the adequacy of the data collected during the CAI.

Decision I statement is, *“Is a contaminant present within a CAS at a concentration that could pose an unacceptable risk to human health and the environment.”* Any contaminant detected in the environmental media at concentrations exceeding the corresponding PALs, defined in Section A.1.4.2, will be considered a COC for the purpose of evaluating risk to human health and the environment. The presence of a contaminant within each CAS is defined as the analytical detection of a COC. Samples used to resolve Decision I are identified as Phase I samples.

The Decision II statement is, *“If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?”* Sufficient information is defined as the data needs identified in this DQO process to include the maximum lateral and vertical extent of all COCs within each CAS. Samples used to resolve Decision II are identified as Phase II samples.

A.1.3.2 Alternative Actions to the Decision

For each decision identified in the previous section there is an alternative decision.

The alternative for Decision I is, “If no COCs are present, further assessment of the CAS is not required. If a COC is present, resolve Decision II.”

The alternative for Decision II is, “If the extent of COCs are defined in both the lateral and vertical directions, further assessment of the CAS is not required. If the extent of COCs are not defined, reevaluate site conditions and collect additional samples.”

A.1.4 Step 3 - Identify the Inputs to the Decision

This step identifies the information needed, determines sources for information, determines the basis for establishing the action levels, and identifies sampling and analysis methods that can meet the data requirements. To determine if a COC is present, each sample result or population parameter (Section A.1.6.1) is compared to the PAL (Section A.1.4.2). If any sample result or population parameter is greater than the PAL, then the CAS is advanced to Decision II (define the lateral and vertical extent) for that analyte. This approach does not use a statistical mean/average for comparison to the PAL, but rather the individual result, to identify COCs.

A.1.4.1 Information Needs and Information Sources

In order to determine if a COC is present at a CAS, sample data must be collected and analyzed following these two criteria: (1) samples must be collected in areas most likely to contain a COC, and (2) the analytical suite selected must be sufficient to detect any COCs present in the samples. Biasing factors to support these criteria include:

- Previous sample results
- Documented process knowledge on source and location of release
- Field observations
- Field-screening data
- Experience and data from investigations of similar sites
- Professional judgment

In order to determine the extent of a COC for Decision II, sample data must be collected and analyzed at locations to bound the lateral and vertical extent of COCs. The data required to satisfy the information needed for each COC is a sample result that is below the PAL. Step-out locations as defined in Section A.1.8 will be selected. Samples will only be analyzed for those parameters that exceeded PALs (i.e., COCs) in prior samples. Biasing factors to support these information needs may include the factors previously listed and Phase I analytical results.

When analytical results or other biasing factors suggest that the COC concentrations at the step-out location(s) may still exceed the PAL, then an additional step-out distance may be used to define the lateral extent of contamination. At CAS 01-25-01, the step-out location will be limited to the lateral limits of the gravel containment area berm. At CASs 03-25-03 and 03-20-05, the step-out locations will be limited to not more than 25 ft outside the lateral boundaries or physical features. If a location where the PAL is exceeded is surrounded by clean locations, then lateral step-outs may not be necessary. In that case, sampling may consist only of sampling from deeper intervals at or near the original location to determine the vertical extent of contamination. Vertical extent samples will be collected from depth intervals that will meet DQO objectives in a manner that will conserve resources during possible remediation. Biasing factors to support these information needs may include the factors previously listed and Phase I analytical results. Sampling locations may be moved due to access, underground utilities, or safety issues; however, the modified locations must meet the decision requirements and criteria necessary to fulfill the information needs.

Table A.1-4 lists the information needs, the source of information for each need, and the proposed methods to collect the data needed to resolve Decisions I and II. The last column addresses the QA/QC data type and associated metric. The data type is determined by the intended use of the resulting data in decision making, such as selecting the appropriate corrective action.

Data types are discussed in the following text. All data to be collected are classified into one of three measurement quality categories: quantitative, semiquantitative, and qualitative. The categories for measurement quality are defined below.

Quantitative Data

Quantitative data results from direct measurement of a characteristic or component within the population of interest. These data require the highest level of QA/QC in collection and measurement systems because the intended use of the data is to resolve the primary decision (i.e., rejecting or accepting the null hypothesis) and/or verifying closure standards have been met. Laboratory analytical data are usually assigned as quantitative data.

Semiquantitative Data

Semiquantitative data is generated from a measurement system that indirectly measures the quantity or amount of a characteristic or component of interest. Inferences are drawn about the quantity or amount of a characteristic or component because a correlation has been shown to exist between results from the indirect measurement and the quantitative measurement. The QA/QC requirements on semiquantitative collection and measurement systems are high but may not be as rigorous as the quantitative measurement system. Semiquantitative data contribute to decision making, but are not generally used alone to resolve primary decisions. Field-screening data are generally considered semiquantitative. The data are often used to guide investigations toward quantitative data collection.

Table A.1-4
Information Needs to Resolve Decisions I and II
(Page 1 of 3)

Information Need	Information Source	Collection Method	Biasing Factors to Consider	Data Type/Metric
Decision I (Phase I): Determine if a COC is present. Criteria I: Samples must be collected in areas most likely to contain a COC.				
Source and location of release points	Process knowledge, historical documentation, and previous investigations of similar sites	Information documented in CSM and public reports – no additional data needed	None	Qualitative - CSM has not been shown to be inaccurate
	Field observations	Conduct site visits and document field observations	Visible evidence of contamination, topographic lows, gullies	Qualitative - CSM has not been shown to be inaccurate
	Aerial photographs	Review and interpret aerial photographs	Disturbed areas, visible evidence of contamination, location of possible sources	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Field screening	Review and interpret field-screening results (FSRs)	Bias sample locations/ intervals based on elevated FSRs	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Radiological surveys	Review and interpret radiological surveys	Bias sample locations/ intervals based on elevated FSRs	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Existing analytical data	Review and interpret sampling results	Bias sample locations based on previous results	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
Nature of contamination	Biased samples	Collect samples from locations/depths based on biasing factors	Send samples with highest survey/screening results to laboratory	Semiquantitative - Sampling based on survey and screening results
	Biased samples	Collect samples from additional locations near CAS features	Worst-case locations such as edge of pad	Semiquantitative - Sampling based on CAS features

Table A.1-4
Information Needs to Resolve Decisions I and II
(Page 2 of 3)

Information Need	Information Source	Collection Method	Biasing Factors to Consider	Data Type/Metric
Decision I (Phase I): Determine if a COC is present. Criteria 2: Analyses must be sufficient to detect any COCs in samples.				
Identification of all potential contaminants	Process knowledge and previous investigations of similar sites; use analytical suite in Table A.1-6.	Information documented in CSM and public reports – no additional data needed; comprehensive analytical suite developed to account for uncertainty	None	Qualitative - CSM has not been shown to be inaccurate
Analytical results	Data packages from biased samples	Appropriate sampling techniques and approved analytical methods will be used; minimum reporting limits (MRLs) are sufficient to provide quantitative results for comparison to PALs	None	Quantitative - Validated analytical results will be compared to PALs
Decision II (Phase II): Determine the extent of a COC. Criteria: Sample collection and analysis methods must be sufficient to bound extent of COC.				
Identification of applicable COCs	Data packages of Phase I samples	Review analytical results and compare to PALs to select COCs	None	Quantitative - Only COCs identified will be analyzed in future sampling events
Extent of contamination	Field observations	Document field observations	Visible evidence of contamination	Qualitative - CSM has not been shown to be inaccurate
	Field screening	Conduct field screening using appropriate methods	Bias sample locations/ intervals based on FSRs	Semiquantitative - FSRs will be compared to field-screening levels
	Step-out samples	Generate locations based on previous sampling results and biasing factors	Locations selected based on the initial sampling results for both horizontal and vertical sampling	Semiquantitative - Sampling based on previous results and biasing factors
	Data packages of analytical results	Appropriate sampling techniques and approved analytical methods will be used to bound COCs; MRLs are sufficient to provide quantitative results for comparison to PALs	None	Quantitative - Validated analytical results will be compared to PALS to determine COC extent

Table A.1-4
Information Needs to Resolve Decisions I and II
(Page 3 of 3)

Information Need	Information Source	Collection Method	Biasing Factors to Consider	Data Type/Metric
Decision: Determine if sufficient information exists to characterize waste. Criteria: Analyses must be sufficient to allow disposal options to be accurately identified and estimated.				
Analytical results	Data packages of analytical results; use analytical suite in Table A.1-6; require TCLP if results are >20X TCLP limits or if PCB contamination exceeds 50 ppm	Appropriate sampling techniques and approved analytical methods will be used; MRLs and minimum detectable activities are sufficient to provide quantitative results for comparison to disposal requirements	Sufficient material must be available for analysis	Quantitative - Validated analytical results will be compared to disposal criteria

Qualitative Data

Qualitative data identifies or describes the characteristics or components of the population of interest. The QA/QC requirements for qualitative data are the least rigorous on data collection methods and measurement systems. Professional judgment is often used to generate qualitative data. The intended use of the data is for information purposes, to refine conceptual models, and guide investigations rather than resolve primary decisions. This measurement of quality is typically associated with historical information and data where QA/QC may be highly variable or not known. Professional judgment is often used to generate qualitative data.

Metrics provide a tool to determine if the collected data support decision making as intended. Metrics tend to be numerical for quantitative and semiquantitative data and descriptive for qualitative data.

A.1.4.2 Determine the Basis for the Preliminary Action Levels

Industrial site workers and construction/remediation workers may be exposed to contaminants through oral ingestion, inhalation, external (radiological), or dermal contact (absorption) of soil during disturbance of this media. Laboratory analytical results for soils will be compared to the following PALs to evaluate if COPCs are present at levels that may pose an unacceptable risk to human health and/or the environment (i.e., COCs):

- EPA Region IX Risk-Based PRGs for Industrial Soils (EPA, 2002b).
- For detected COPCs without established PRGs, a similar protocol to that used by EPA Region IX will be used in establishing an action level for those COPCs listed in IRIS (EPA, 2002a)
- Background concentrations for RCRA will be used instead of PRGs when natural background exceeds the PRG, as is often the case with arsenic on the NTS. Background is considered the mean plus two times the standard deviation of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999).
- TPH action level of 100 mg/kg per the NAC 445A.2272 (NAC, 2002a).
- The PALs for radionuclides are isotope-specific and defined as the maximum concentration for that isotope found in environmental samples taken from undisturbed background locations in the vicinity of the NTS, as presented in McArthur and Miller (1989) and US Ecology and Atlan-Tech (1991). The PAL is equal to the minimum detectable activity (MDA) for isotopes not reported in soil samples from undisturbed background locations or if the PAL is less than the MDA. PALs are defined as the isotope-specific concentration in units of pCi/g and presented in Table 3-4 of the CAIP.

The assumptions used were soil is likely to be disturbed due to present or future construction activities, activities involving earthmoving, and/or industrial or commercial activities; children will not be present; and there will be no dwellings on site. The critically exposed group consists of adult workers exposed to external radiation and/or subjected to inhalation and ingestion of suspended contaminated soil. The doses from construction and earthmoving activities are likely to be short-term; therefore, the screening limits will be more conservative than long-term exposures.

A.1.4.3 Potential Sampling Techniques and Appropriate Analytical Methods

As defined in Step 3, the collection, measurement, and analytical methods will be determined such that results will be generated for all of the identified potential contaminants as well as other suspected contaminants at a CAS. This effort will include field sampling, soil sampling, and laboratory analysis to determine the presence of COPCs and extent of identified COCs.

For the three CASs, site characterization sampling and analysis are the focus of the DQO process. However, waste characterization sampling and analysis has been included to support the decision-making process for waste management and to ensure an efficient field program. Soil samples will be submitted for IDW analysis, as necessary. Specific analyses required for the disposal of IDW are identified in Section 5.0 of the CAIP.

A.1.4.3.1 Geophysical Surveys

Electromagnetic surveys will be used to determine presence/lateral extent of buried utility lines, buried structures, and potential for buried waste at CASs 03-25-03 and 03-20-05. Resistivity surveys will be used to determine presence/vertical depth of possible buried utilities, buried structures, and waste.

A.1.4.3.2 Field Screening

Field-screening activities may be conducted for the following analytes and/or parameters:

- ***Alpha, Beta, and Gamma Radiation*** **-** A handheld radiological survey instrument or method may be used because radiologically contaminated soil or concrete may be present at CASs 03-25-03 and 03-20-05 based on the historical information and posted sign warnings of potential for radiological contamination.

- ***Gamma Radiation*** **-** Gamma spectroscopy, or equivalent instrument or method, may be used on an as needed basis at CASs 03-20-03 and 03-25-03. Gamma spectroscopy may be needed at CAS 03-20-05 injection wells and the BOP Shop based on process knowledge and posted radiological warning signs. Gamma dose rates may also be monitored during CAS 03-25-03 Mud Plant investigation to determine the potential dose in personnel to gamma radiation from previous site activities at the mud disposal pit.

- ***VOCs*** **-** A photoionization detector (PID), and/or equivalent instrument or method, will be used to conduct headspace analysis at all CASs because VOCs are a common concern at the NTS and have not been ruled out based on process knowledge at CAU 322.

- ***TPH*** **-** A gas chromatograph, or equivalent instrument or method, will be used at all CASs because TPH contamination has been detected at CASs 03-25-03 and 03-20-05. It is representative of general characteristics of petroleum hydrocarbon/diesel fuel, and is a common concern at the NTS that has not been ruled out based upon process knowledge at CAU 322.

Based on the results of previous CAU investigations and common NTS practices, the aforementioned field-screening techniques may be applied during Phase I and Phase II sampling at all CASs. These field-screening techniques will provide semiquantitative data that can be used to guide confirmatory soil sampling activities.

A.1.4.3.3 Soil Sampling

Hand sampling, augering, direct-push, excavation, drilling, or other appropriate sampling methods will be used to collect soil samples for laboratory analysis. Sample collection and handling activities will be conducted in accordance with the contractor's approved procedures.

A.1.4.3.4 Analytical Program

The analytical program for each CAS in CAU 322 are listed in Table A.1-5, and was developed based on the suspected-contamination information presented in Section A.1.1. The table identifies the critical and noncritical COPCs for each CAS and Table A.1-6 provides the laboratory methods for each analyte. The COPCs are TPH-DRO and oil-range organics, VOCs, SVOCs, RCRA metals, PCBs, and radionuclides.

The critical and noncritical COPCs are known or suspected of being present at each CAS based on process knowledge, preliminary sampling, and other historic information. The critical COPCs are given greater importance in the decision-making process relative to noncritical COPCs. For this reason, more stringent performance criteria are specified for critical analytical DQIs (Section 6.0 of the CAIP). Noncritical COPCs are defined as classes of contaminants that include all the analytes reported from the respective analytical methods that have PALs. Table A.1-7 lists the analytes for CAU 322. The noncritical COPCs also aid in reducing the uncertainty concerning the history and potential releases from the CAS and help in the accurate evaluation of potential contamination. If a COPC, either critical or noncritical, is detected in any sample at a concentration above the respective PAL, the COPC will be identified as a COC and considered critical in the decision process.

Section 3.0 and Section 6.0 the CAIP provide the analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) to be followed during this CAI, respectively. Sample volumes are laboratory- and method-specific and will be determined in accordance with laboratory

Table A.1-5
Analytical Program for CAU 322

Analyses[a]	CAS 01-25-01	CAS 03-25-03	CAS 03-20-05
Organics			
Total Petroleum Hydrocarbons (Diesel-, and Oil-Range Organics)	C	C	C
Volatile Organic Compounds	X	X	C
Polychlorinated Biphenyls	X	X	C
Semivolatile Organic Compounds	X	X	C
Radiological			
Radiological Screening	None	X	C
Metals			
Total *Resource Conservation and Recovery Act* Metals[b]	X	X	C
Beryllium	X	X	X

[a] If the volume of material is limited, prioritization of the analyses will be necessary.
[b] May also include Toxicity Characteristic Leaching Procedure metals if the sample is collected for waste management purposes.

C = Critical COPCs   X = Non-critical COPCs

requirements. Analytical requirements (e.g., methods, detection limits, precision, and accuracy) are specified in the Industrial Sites QAPP (NNSA/NV, 2002), unless superseded by the CAIP. These requirements will ensure that laboratory analyses are sufficient to detect contamination in samples at concentrations exceeding the MRLs. Specific analyses, if any, required for the disposal of IDW are identified in Section 5.0 of the CAIP.

For sampling performed to define the extent of contamination (Decision II) at the individual CASs, samples will be collected and analyzed only for COCs identified in samples collected to resolve Decision I. However, if extent samples are collected prior to nature-of-contamination data becoming available, the extent samples will be analyzed for the full list parameters given in Table A.1-5. For samples collected to define the extent of contamination, critical analytes are unbounded COCs.

The analyses to be conducted for samples collected for this CAU are listed in Table A.1-6, and Table A.1-7 lists the analytes reported by the various analytical methods that are considered to be COPCs.

Table A.1-6
Analytical Methods for Laboratory Analysis

Analytical Parameter	Analytical Method	
	Liquid	Soil/Sediment/Sludge
Total Volatile Organic Compounds	SW-846 8260B[a]	SW-846 8260B[a]
Total Semivolatile Organic Compounds	SW-846 8270C[a]	SW-846 8270C[a]
Total RCRA Metals, plus Beryllium	SW-846 6010B[a] (mercury - 7470A[a])	SW-846 6010B[a] (mercury - 7471A[a])
Polychlorinated Biphenyls	SW-846 8082[a]	SW-846 8082[a]
Total Petroleum Hydrocarbons, GRO and DRO (C_6 - C_{38})	SW-846 8015B[a] (modified)	SW-846 8015B[a] (modified)
Gamma Spectrometry (gamma emitters, e.g., Cs-137)	EPA Procedure 901.1[b]	HASL-300[c]
Strontium-90	ASTM D5811-00[d]	HASL-300[c]
Isotopic Plutonium	ASTM D3865-97[e]	ASTM C1001-90[f]
Isotopic Uranium	ASTM D3972-97[g]	ASTM E1000-90[h]

ASTM = American Society of Testing and Materials
RCRA = *Resource Conservation and Recovery Act*
SW = Solid Waste

[a] *EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* 3rd Edition, Parts 1-4, SW-846 (EPA, 1996)
[b] *Prescribed Procedure for Measurements of Radioactivity in Drinking Water* (EPA, 1980)
[c] *The Procedures Manual of the Environmental Measurements Laboratory* (DOE, 1997)
[d] *Standard Test Method for Strontium-90 in Water* (ASTM, 2000c)
[e] *Standard Test Method for Plutonium in Water* (ASTM, 2000b)
[f] *Standard Test Method for Radiochemical Determination of Plutonium in Soil by Alpha Spectroscopy* (ASTM, 2000a)
[g] *Standard Test Method for Isotopic Uranium in Water by Radiochemistry* (ASTM, 2002)
[h] *Standard Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectrometry* (ASTM, 2000b)

A.1.5 Step 4 - Define the Boundaries of the Study

The purpose of this step is to define the target population of interest, specify the spatial and temporal features of the population that are pertinent for decision making, determine practical constraints on data collection, and define the scale of decision making relevant to target populations for Decision I and Decision II.

A.1.5.1 Define the Target Population

Decision I target populations represent locations within the CAS that contain COCs, if present. Decision II target populations are areas within the CAS where COC concentrations are less than PALs and are contiguous to areas of COC contamination. The target populations are dependent upon

Table A.1-7
Analytes for CAU 322

Volatile Organic Compounds	Semivolatile Organic Compounds	Total Petroleum Hydrocarbons	Polychlorinated Biphenyls	Metals	Radionuclides
1,1,1-Trichloroethane	1,2,4-Trichlorobenzene[a]	Total Petroleum Hydrocarbons [C_6-C_{38}]	Aroclor-1016	Arsenic	Americum-241
1,1,2,2-Tetrachloroethane	1,2-Dichlorobenzene[a]	DRO, GRO	Aroclor-1221	Barium	Cesium-137
1,1,2-Trichloroethane	1,3-Dichlorobenzene[a]		Aroclor-1232	Cadmium	Plutonium-238
1,1-Dichloroethane	1,4-Dichlorobenzene[a]		Aroclor-1242	Chromium	Plutonium-239/240
1,1-Dichloroethene	2,4,5-Trichlorophenol		Aroclor-1248	Lead	Strontium-90
cis-1,2-Dichloroethene	2,4,6-Trichlorophenol		Aroclor-1254	Mercury	Uranium-234
cis-1,3-Dichloropropene	2,4-Dichlorophenol		Aroclor-1260	Selenium	Uranium-235
trans-1,2-Dichloroethene	2,4-Dimethylphenol			Silver	Uranium-238
1,2-Dichloroethane	2,4-Dinitrophenol			Beryllium	Cobalt-60
1,2-Dichloropropane	2,4-Dinitrotoluene				Tritium
2-Butanone	2,6-Dinitrotoluene				
2-Hexanone	2-Chloronaphthalene				
4-Methyl-2-pentanone	2-Chlorophenol				
Acetone	2-Methylphenol				
Benzene	2-Nitroaniline				
Bromochloromethane	3,3'-Dichlorobenzidine				
Bromodichloromethane	4-Bromophenyl phenyl ether				
Bromoform	4-Chloroaniline				
Bromomethane	4-Methylphenol				
Carbon disulfide	4-Nitrophenol				
Carbon tetrachloride	Acenaphthene				
Chlorobenzene	Acenaphthylene				
Chloroethane	Anthracene				
Chloroform	Benzo(a)anthracene				
Chloromethane	Benzo(a)pyrene				
Dibromochloromethane	Benzo(b)fluoranthene				
Ethylbenzene	Benzo(g,h,i)perylene				
Methyl tertiary butyl ether	Benzo(k)fluoranthene				
Methylene chloride	Bis(2-chloroethoxy) methane				
Styrene	Bis(2-chloroethyl)ether				
Tetrachloroethene	Bis(2-chloroisopropyl)ether				
Toluene	Bis(2-ethylhexyl) phthalate				
trans 1,3-Dichloropropene	Butyl benzyl phthalate				
Trichloroethene	Chrysene				
Vinyl acetate	Dibenzo(a,h)anthracene				
Vinyl chloride	Dibenzofuran				
Xylene	Diethyl Phthalate				
1,1,1,2-Terrachloroethane	Dimethyl Phthalate				
1,2,3-Trichloropropare	Di-n-butyl Phthalate				
1,2,4-Trimethyl-benzene	Di-n-octyl Phthalate				
1,2-Dibromo-3-chloropropane	Fluoranthene				
1,2-Dibromoethane	Fluorene				
1,3,5-Trimethylbenzene	Hexachlorobenzene				
1,3-Dichloropropane	Hexachlorobutadiene[a]				
Trichlorofluoromethane	Hexachlorocyclopentadiene				
Trichlorotrifluoroethane	Hexachloroethane				
n-propyl benzene	Indeno(1,2,3-cd)pyrene				
2-chloltoluene	Isophorone				
Bromobenzene	Naphthalene[a]				
Dichlorodifluoromethane	Nitrobenzene				
Iodomethane	N-Nitroso-di-n-propylamine				
Isopropyl Benzene	N-Nitrosodimethylamine				
n-Butylbenzene	N-Nitrosodiphenylamine				
sec-butylbenzene	Pentachlorophenol				
terr-butylbenzene	Phenanthrene				
	Phenol				
	Pyrene				
	Pyridine				

[a] May be reported with VOCs.

RCRA = *Resource Conservation and Recovery Act* the CSM developed for CAS 25-27-03. These target populations represent locations within the CAS that, when sampled, will provide sufficient data to resolve the primary problem statement (Section A.1.3.1).

A.1.5.2 Identify the Spatial and Temporal Boundaries

In general, geographic (spatial) boundaries (Table A.1-8) are defined by the area impacted from releases attributed to each CAS. Intrusive sampling activities are not intended to extend into the boundaries of neighboring areas of environmental concern (e.g., other CASs).

Temporal boundaries are those time constraints set up by weather conditions and project schedules. Significant temporal constraints due to weather conditions are not expected. Moist weather may place constraints on sampling and field screening of contaminated soils because of the attenuating effect of moisture in samples (e.g., alpha-emitting radionuclides). There are no time constraints on collecting samples as environmental conditions at all sites will not significantly change in the near future and conditions would have stabilized over the years since the site was last used.

A.1.5.3 Identify Practical Constraints

The NTS-controlled activities may affect the ability to characterize some CASs. The effects of these activities (i.e., practical constraints) will be addressed in this section on a CAS-specific basis.

Table A.1-8
Spatial Boundaries for CAU 322

CAS	Spatial Boundary	
	Horizontal	Vertical
01-25-01	The exterior edge of the gravel containment berm	A maximum of 15 ft bgs
03-25-03	350 ft laterally along the anticipated north-south centerline through the former AST containment area	A maximum of 50 ft bgs
03-25-03	80 ft laterally extending from the building towards the east, north and south, approximately 10 ft to the west (concrete slab)	A maximum of 50 ft bgs
03-20-05	25 ft laterally extending from the edge of concrete slab	A maximum of 50 ft bgs
03-20-05	Up to 350 ft laterally around the injection wells	A maximum of 500 ft bgs

Practical constraints include underground utilities and overhead utilities, rough terrain, which may limit intrusive sampling locations. Access restrictions include both scheduling conflicts on the NTS with other entities and areas posted as contamination areas requiring appropriate work controls, physical barriers (e.g., fences, steep slopes), and areas requiring authorized access. Underground utility surveys will be conducted at each CAS prior to the start of investigation activities to determine if utilities exist, and, if so, determine the limit of spatial boundaries for intrusive activities.

A.1.5.4 Define the Scale of Decision Making

The scale of decision making in Phase I is defined as the CAS. The scale of decision making in Phase II is defined as a contiguous area contaminated with any COC originating from the CAS.

A.1.6 Step 5 - Develop a Decision Rule

This step integrates outputs from the previous step with the inputs developed in this step into a decision rule ("If..., then...") statement. This rule describes the conditions under which possible alternative actions would be chosen.

A.1.6.1 Specify the Population Parameter

The population parameter for Phase I data collected from biased sample locations is the maximum observed concentration of each COC within the target population.

The population parameter for Phase II will be the observed concentration of each unbounded chemical COC in any sample.

A.1.6.2 Choose an Action Level

Action levels are defined as the PALs, which are specified in Section A.1.4.2.

A.1.6.3 Decision Rule

If the concentration of any COPC in a target population exceeds the PAL for a COPC in a Phase I sample, then that COPC is identified as a COC, and the extent of contamination (Phase II) sampling will be conducted. If the Site Supervisor determines that an indicator of contamination is present, then Phase II sampling may be conducted before the results of Phase I sampling are available. If all

COPC concentrations are less than the corresponding PALs, then the decision will be no further actions. Based on prior sampling results, the CAI at CAS 25-27-03 will include extent (Phase II) sampling.

If the observed population parameter of any COC in a Phase II sample exceeds the PALs, then additional samples will be collected to complete the Phase II evaluation. If all observed COC population parameters are less than PALs, then the decision will be that the extent of contamination has been defined in the lateral and vertical directions.

If contamination is inconsistent with the CSM or extends beyond the identified spatial boundaries, then work will be suspended and the investigation strategy will be reevaluated. If contamination is consistent with the CSM and is within spatial boundaries, then the decision will be to continue sampling to define extent.

A.1.7 Step 6 - Specify the Tolerable Limits on Decision Errors

The sampling approach for the investigation relies on biased sampling locations; therefore, statistical analysis is not appropriate. Only validated analytical results (quantitative data) will be used to determine if COCs are present (Phase I) or the extent of a COC (Phase II), unless otherwise stated. The baseline condition (i.e., null hypothesis) and alternative condition for Phase I are:

- Baseline condition – A COC is present
- Alternative condition – A COC is not present

The baseline condition (i.e., null hypothesis) and alternative condition for Phase II are:

- Baseline condition – The extent of a COC has not been defined
- Alternative condition – The extent of a COC has been defined

Decisions and/or criteria have an alpha (false rejection) or beta (false acceptance) error associated with their determination (discussed in the following subsections). Since quantitative chemical data are individually compared to action levels on a point-by-point basis, statistical evaluations of the data such as averages or confidence intervals are not appropriate.

A.1.7.1 False Rejection Decision Error

The false negative (rejection of the null hypothesis or alpha error) decision error would mean:

- Deciding that a COC is not present when it actually is (Decision I).
- Deciding that the extent of a COC has been defined when it actually has not (Decision II).

In both cases, this would result in an increased risk to human health and the environment.

For Decision I, a false negative decision error (where the consequences are more severe) is controlled by meeting the following criteria:

- Having a high degree of confidence that the sample locations selected will identify COCs if present anywhere within the CAS.

- Having a high degree of confidence that analyses selected will be sufficient to detect any COCs present in the sampled media and that the detection limits are adequate to ensure an accurate quantification of the COCs.

For Decision II, the false negative decision error is reduced by :

- Having a high degree of confidence that the sample locations selected will identify the extent of COCs.

- Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.

- Having a high degree of confidence that the dataset is of sufficient quality and completeness. The sample locations selected will identify the extent of COCs.

To satisfy the first criterion for both decisions, Phase I samples will be collected in areas most likely to be contaminated by any COPCs, and Phase II samples will be collected in areas that represent the lateral and vertical extent of COCs. The following characteristics are considered during both phases to accomplish the first criterion:

- Source and location of release
- Chemical nature and fate properties
- Physical transport pathways and properties
- Hydrologic drivers

These characteristics were considered during the development of the CSMs and selection of sampling locations. The biasing factors listed in Table A.1-4 of Section A.1.4.1 will be used to further ensure that these criteria are met.

To satisfy the second criterion for Decision I, all samples used to define the nature of contamination will be analyzed for the parameters listed in Section A.1.4.3.4 using analytical methods that are capable of producing quantitative data at concentrations below or equal to PALs (unless stated otherwise in the CAIP). To satisfy the second criterion for Decision II, Phase II samples will be analyzed for those parameters that identified unbounded COCs.

To satisfy the third criterion for Decision II, the entire dataset, as well as individual sample results, will be assessed against the DQIs of precision, accuracy, comparability, completeness, and representativeness, as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The goal for the DQI of completeness is that 90 percent of the critical COPC results are valid for every sample. Critical COPCs are defined as those contaminants that are known or expected to be present within a CAS (Section A.1.4.3.3). In addition, sensitivity has been included as a DQI for laboratory analyses. Site-specific DQIs are discussed in more detail in Section 6.0 of the CAIP. Strict adherence to established procedures and QA/QC protocol protects against false negatives.

A.1.7.2 False Positive Decision Error

The false positive (acceptance of the null hypothesis or beta) decision error would mean:

- Deciding that a COC is present when it actually is not (Decision I).
- Accepting that the extent of a COC has not been defined when it really has (Decision II).

These errors result in increased costs for unnecessary characterization or corrective actions.

The false positive decision error is controlled by protecting against false positive analytical results. False positive results are typically attributed to laboratory and/or sampling/handling errors. Quality assurance/quality control samples such as field blanks, trip blanks, laboratory control samples, and method blanks are used to determine if a false positive analytical result may have occurred. Other measures include proper decontamination of sampling equipment and using certified clean sample containers to avoid cross contamination.

A.1.7.3 Quality Assurance/Quality Control

Radiological survey instruments and field-screening equipment will be calibrated and checked in accordance with the manufacturer's instructions or approved procedures.

Quality control samples will be collected as required by the Industrial Sites QAPP (NNSA/NV, 2002) and in accordance with established procedures. The required QA field samples include:

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per lot for such things as polyurethane bags or direct-push liners)
- Field duplicates (minimum of 1 per matrix per 20 environmental samples or 1 per CAS if less than 20 collected)
- Field blanks (minimum of 1 per 20 environmental samples or 1 per CAS if less than 20 collected)
- Matrix spike/matrix spike duplicate (minimum of 1 per 20 environmental samples or 1 per CAS per matrix if less than 20 collected, not required for all radionuclide measurements)

Additional QC samples may be submitted based on site conditions.

Data quality indicators of precision, accuracy, comparability, completeness, and representativeness are defined in the Industrial Sites QAPP (NNSA/NV, 2002). In addition, sensitivity has been included as a DQI for laboratory analyses. Site-specific DQIs are discussed in more detail in Section 6.0 of the CAIP.

A.1.8 Step 7 - Optimize the Design for Obtaining Data

This section presents an overview of the resource-effective strategy to be used to obtain the data required to meet the project DQOs developed in the previous six steps. Section A.1.8.1 provides general investigation strategy. Sections A.1.8.1.1, A.1.8.1.2, and A.1.8.1.3 provide the detailed sampling approach to resolve the decision statements for CAU 322.

A.1.8.1 General Investigation Strategy

The initial activities to be conducted will be a visual inspection and geophysical survey of the proposed study areas at each CAS within CAU 322. The visual inspections and geophysical surveys will provide additional biasing factors for locating soil samples and to identify any potential conditions that may affect sampling and sample locations.

Following visual inspection and geophysical surveys, surface soil field-screening sample locations will be established. When available, this effort will use the data from previously collected samples and other biasing factors to identify sampling points at each parcel. Previous analytical data will be used in the decision process if the data meets the quality criteria specified in the DQOs.

Once sampling locations have been selected, surface soil samples may be collected and field screened for CAS-specific parameters. Where COCs are known to exist, based on previous sampling and field-screening results, Phase I (Decision I) surface and shallow subsurface soil samples will be collected for laboratory analysis for the parameters identified in Section A.1.4.3.4.

Phase II (step-out) sampling locations at each parcel will be selected based on the outer boundary sample locations where COCs were detected, the CSM, other biasing factors, and field/site conditions (e.g., limitations posed by steep terrain, existing structure). If biasing factors indicate COCs extend beyond planned Phase II sample locations, locations may be modified or additional Phase II samples may be collected from incremental step-out locations. If the step-out locations from different original locations approach each other, then the Site Supervisor may consider this as one area, and collect samples only in the outward directions.

Contaminants determined not to be present in Phase I samples will be eliminated from Phase II analytical suites. In general, samples submitted for off-site analysis will be those that define the nature and extent (lateral and vertical) of COCs.

The following are the primary biasing factors to be considered in the selection of the surface soil field-screening sample locations:

- Aerial photograph review and evaluation
- Visual indicators (e.g., staining, topography, areas of preferential surface runoff)

- Existing site-specific analytical data (PA and CAU 262 sampling data)
- Known or suspected sources and locations of release
- Process knowledge and experience at similar sites
- Information and/or data from adjacent CASs
- Geologic and/or hydrologic conditions
- Physical and chemical characteristics of suspected contaminants

Existing data will provide a semiquantitative evaluation of the presence and extent of potential contamination in surface soil. The adequacy of the TPH and VOC field-screening methods will be assessed by comparing results with the results of laboratory analysis performed on split samples. Samples will be submitted to support Decision I (from worst-case locations) and to support Decision II (confirm the horizontal extent of contamination). Data collected during previous sampling events (if any), FSRs, and the other biasing factors listed above will be used to select locations. If necessary, additional surface soil samples will be submitted for laboratory analysis to ensure that the extent of contamination is defined.

The subsurface soil sample intervals will be based on biasing factors such as presence of debris, staining, odor, FSRs, or professional judgment. For subsurface sampling locations, generally two consecutive soil samples with results below field-screening action levels will be required to define the vertical extent of contamination. Generally, the uppermost “clean” sample from each location will be submitted for laboratory analysis.

Surface soil samples will be collected by hand. Rotary sonic drilling, hollow-stem auger drilling, direct-push, handheld augers, or excavation may be used, as appropriate, to collect subsurface samples. Samples for waste characterization purposes may also be collected at the three CASs.

Due to the nature of buried features possibly present (e.g., structures, buried debris, and utilities), sample locations may be relocated, based upon the review of engineering drawings, and information obtained during the site visit. However, the new locations must meet the decision needs and criteria stipulated in Section A.1.4.1.

The following sections describe the Phase I and II field activities to be conducted at the following CAS locations of CAU 322. Samples will be collected from the proposed biased locations as discussed in the following sections and shown in Figures A.1-8, A.1-9, A.1-11, and A.1-12.

A.1.8.1.1 CAS 01-25-01, AST Release

Phase I activities consist of collecting a minimum of two samples to investigate the vertical and lateral extent of potential contamination in the gravel containment pit. Additional locations may be sampled based on FSRs or at the discretion of the Site Supervisor.

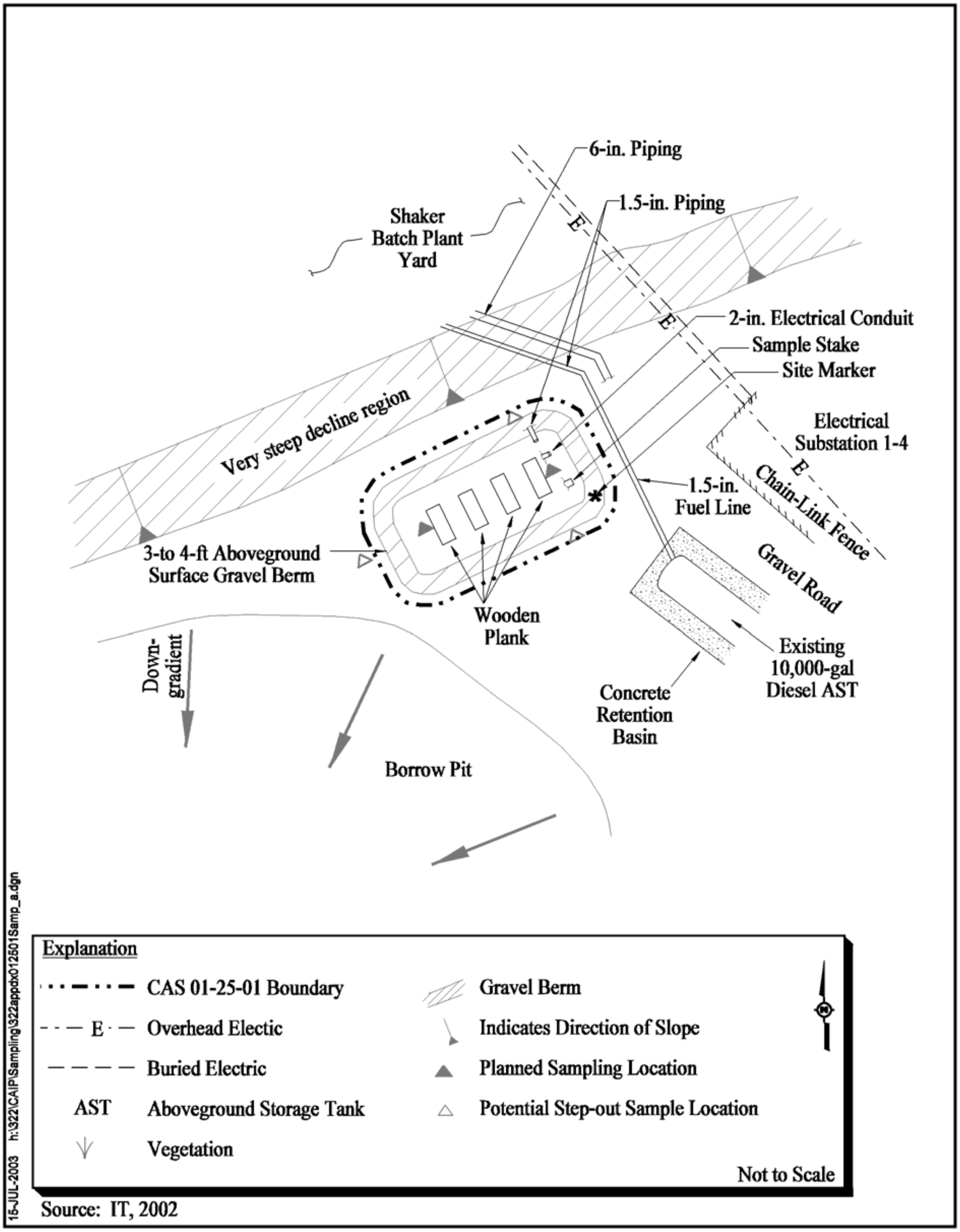
The first sample locations will correspond with the ends of the former tank and beneath the former piping. Samples will be collected at the gravel-native soil interface (0 to 0.5 ft bgs) and at approximately 1-ft intervals at these locations. Additional samples may be collected, at the discretion of the Site Supervisor, to adequately characterize the nature and extent of potential contamination. Samples will be field screened for TPH and VOCs.

Three step-out (both vertical and horizontal) sample locations are arranged around the perimeter of the gravel containment berm. Additional samples will be collected to delineate the extent of the potential hot spots and will be based on the discretion of the Site Supervisor, existing data, and other biasing factors. Depending on the results of the screening, additional step-outs will be performed as necessary. Refer to Figure A.1-8 for proposed sample locations.

A.1.8.1.2 CAS 03-25-03, Mud Plant AST Diesel Release

Area - A: Phase I activities will be performed to confirm the nature of suspected contaminants that may have originated from a former AST and fuel dispenser. Initial activities will include collecting surface and shallow subsurface soil samples for field screening. A minimum of seven locations will be sampled to investigate the vertical and lateral extent of the potential contamination in the area of the former AST and fuel dispenser. Additional locations may be sampled based on FSRs or at the discretion of the Site Supervisor.

The first sample location will be in the center of the former AST gravel containment pit, based on visual observations. The next sampling points will be located at 25-ft intervals north, south, east, and west from the center of the gravel containment area. Additional sampling points will be established at 25- to 50-ft step-out locations in a similar pattern, if initial sampling results exceed FSLs. Field-screening locations will also be established moving east from the AST gravel containment berm along the alignment of buried utilities toward the Mud Plant. No sampling is planned within the



Source: IT, 2002

Figure A.1-8
Sampling Plan for CAS 01-25-01 AST Release

post-shot area. Figure A.1-9 shows a generalized sampling plan for field screening within Area 1 at CAS 03-25-03. Confirmation samples will be selected as previously discussed.

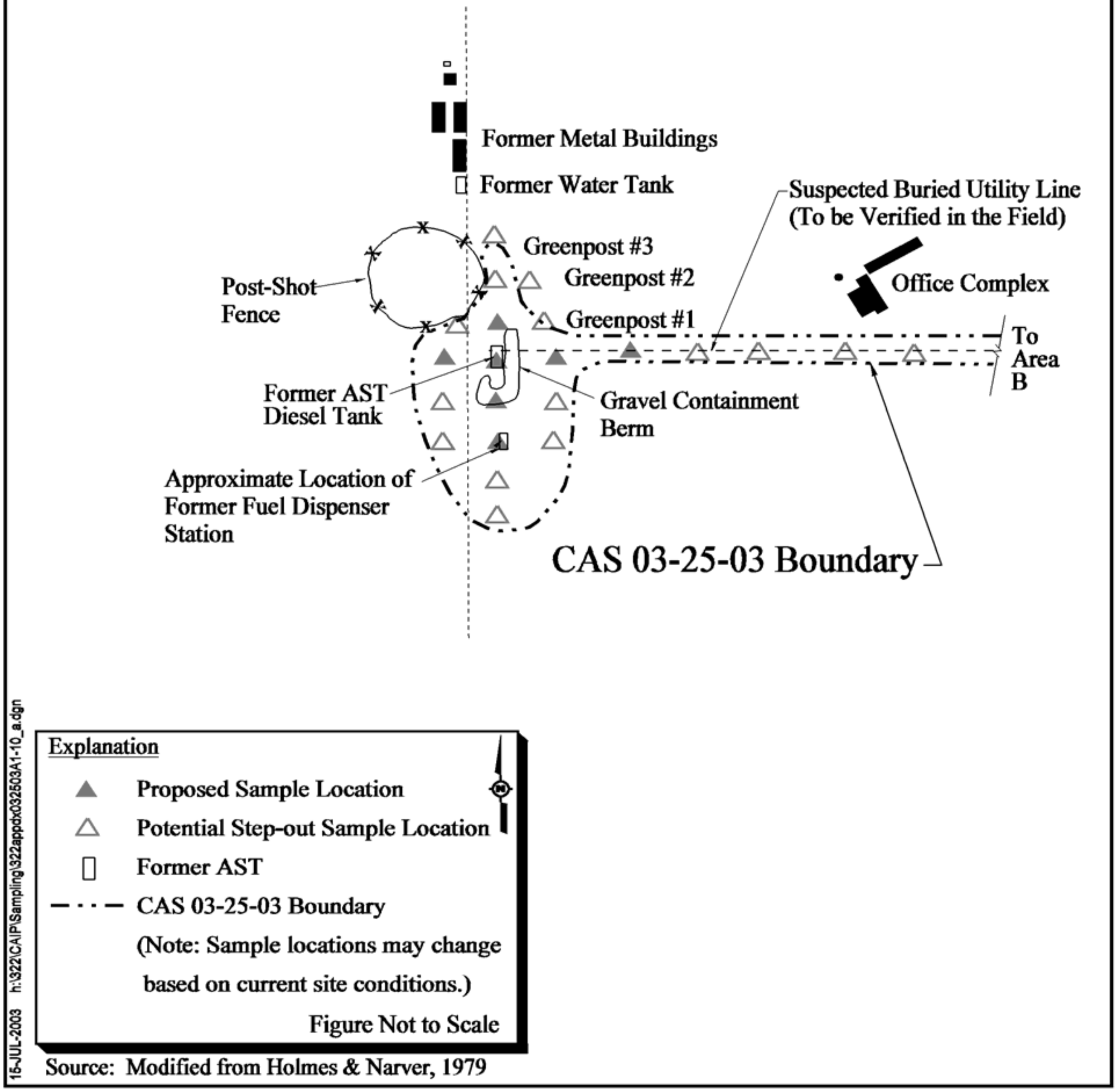
Area - B: Phase I activities will be performed to confirm the nature of suspected contaminants that may have originated from former diesel generators or other potential sources of fuel spills and releases in the area east of the Mud Plant building. Initial activities will include drilling surface and shallow subsurface soil sample for field screening. A minimum of eight locations will be sampled to investigate the vertical and lateral extent of the potential contamination. Additional locations may be sampled based on FSRs or at the discretion of the Site Supervisor. The initial investigation efforts will characterize the site where COCs have been confirmed (CAS 03-44-02) to be present based on existing analytical data. Refer to Figure A.1-10 for a summary of the TPH analytical data.

Samples will be collected during the Phase II sampling to delineate the extent of the potential hot spots identified during the Phase I investigation. During Phase II, step-out sample locations will be selected based on biasing factors (i.e., analytical data, field observations). Initial step-outs will be located beside the Phase I sample locations where COCs were detected. At each Phase II location, soil samples will be collected at the depth where COCs were encountered in Phase I and at 2 sample intervals below the lowest depth where COCs were encountered. Confirmation samples will be selected as previously discussed. Depending on the results of the screening, additional step-outs will be performed, as necessary. Figure A.1-11 shows a generalized sampling plan for field screening at CAS 03-20-05.

Five potential step-out locations have been selected based on field observations, review of existing analytical data, and physical constraints at the site. Additional locations may be sampled based on FSRs or at the discretion of the Site Supervisor.

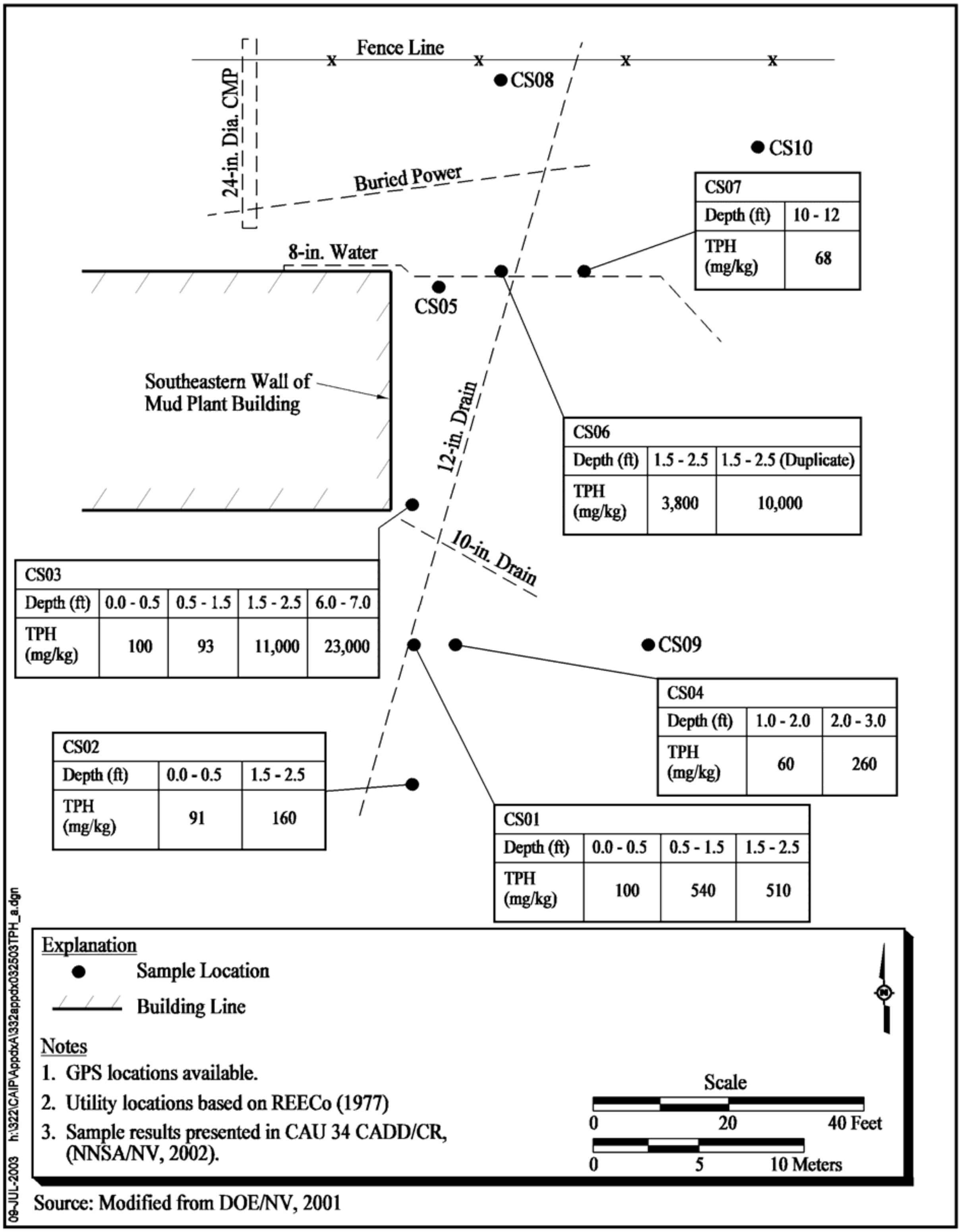
A.1.8.1.3 CAS 03-20-05, Injection Wells

A minimum of three locations will be selected for collection of deep subsurface samples in order to investigate the lateral and vertical extent of contamination at the BOP holding tanks and sumps and the injection well. Additional locations may be sampled based on FSRs or at the discretion of the Site Supervisor. The first sample locations will be located in close proximity to the three holding tanks and sumps, northwest corner and northeast side of the BOP. Selected locations are in close proximity



Source: Modified from Holmes & Narver, 1979

Figure A.1-9
Sample Location Plan for Area A CAS 03-25-03
Mud Plant AST Diesel Release



CS07

Depth (ft)	10 - 12
TPH (mg/kg)	68

CS06

Depth (ft)	1.5 - 2.5	1.5 - 2.5 (Duplicate)
TPH (mg/kg)	3,800	10,000

CS03

Depth (ft)	0.0 - 0.5	0.5 - 1.5	1.5 - 2.5	6.0 - 7.0
TPH (mg/kg)	100	93	11,000	23,000

CS04

Depth (ft)	1.0 - 2.0	2.0 - 3.0
TPH (mg/kg)	60	260

CS02

Depth (ft)	0.0 - 0.5	1.5 - 2.5
TPH (mg/kg)	91	160

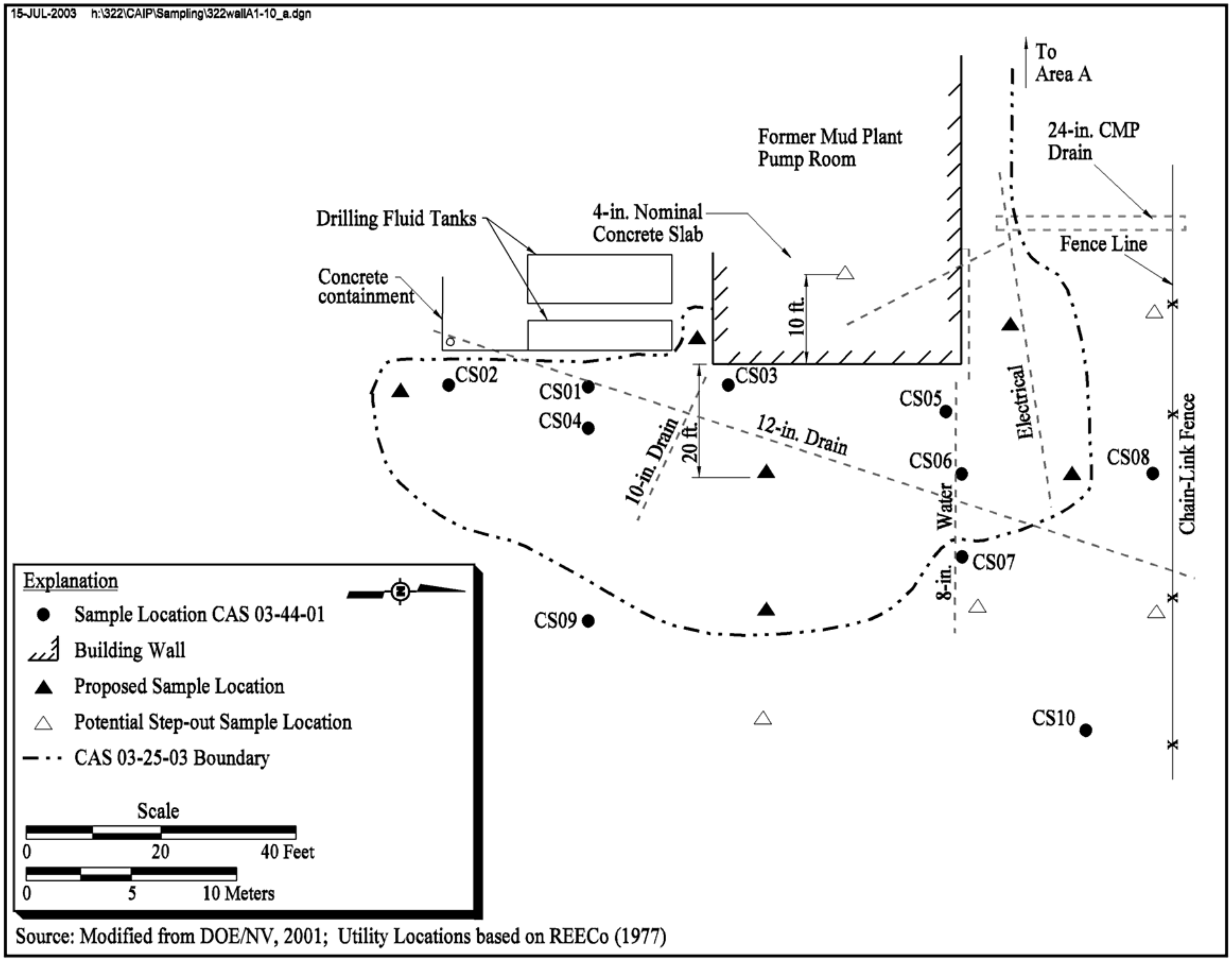
CS01

Depth (ft)	0.0 - 0.5	0.5 - 1.5	1.5 - 2.5
TPH (mg/kg)	100	540	510

Notes
1. GPS locations available.
2. Utility locations based on REECo (1977)
3. Sample results presented in CAU 34 CADD/CR, (NNSA/NV, 2002).

Source: Modified from DOE/NV, 2001

Figure A.1-10
CAS 03-25-03, Summary of TPH Analytical Results for Soil Samples Collected During CAU 34, CAS 03-44-01 Investigation



Source: Modified from DOE/NV, 2001; Utility Locations based on REECo (1977)

Figure A.1-11
Sample Location Plan for Area B CAS 03-25-03 Mud Plant AST Diesel Release

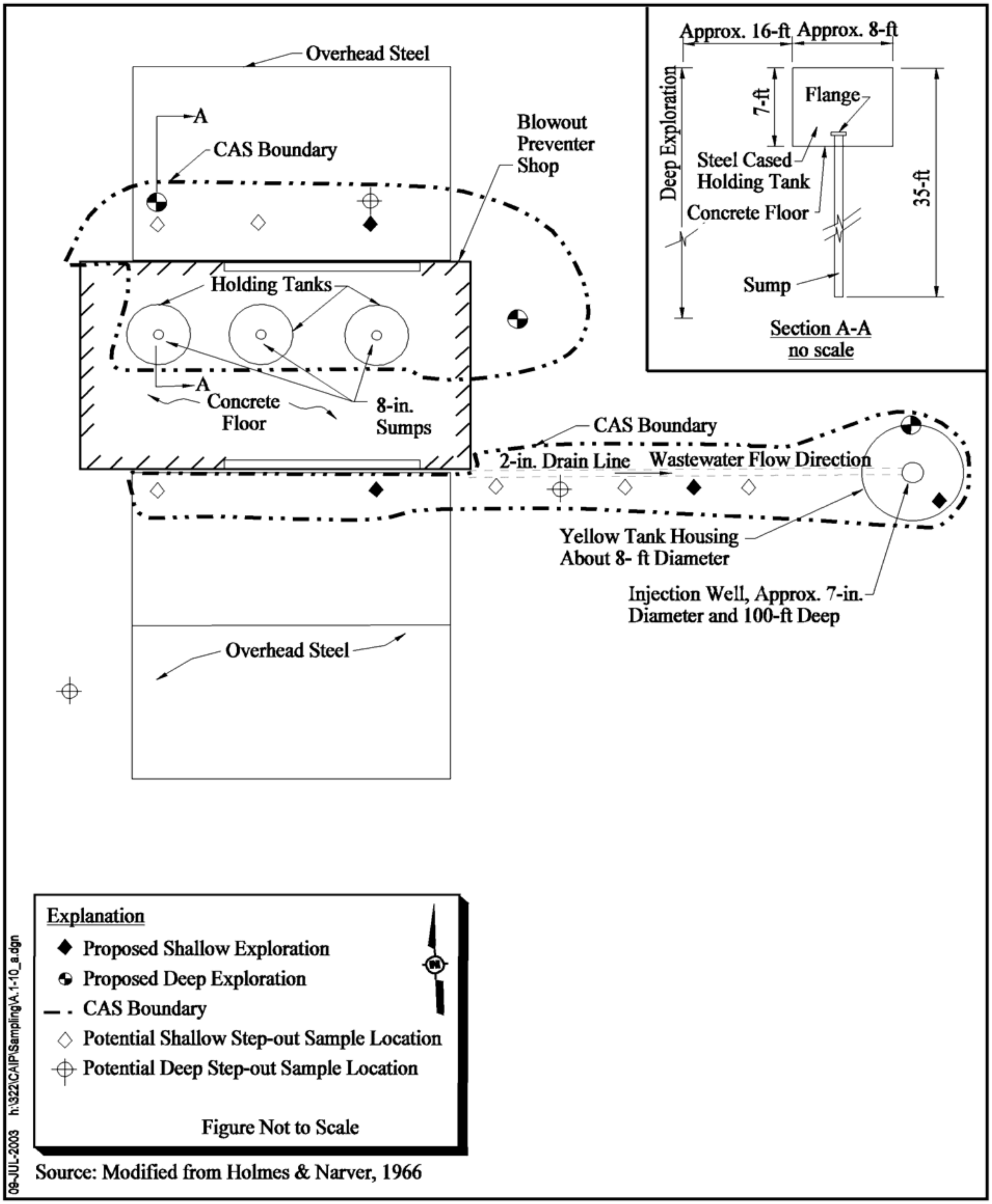
to the two holding tanks used during the cleaning of the blowout preventer equipment. The third sampling location is adjacent to the injection well.

The sample locations were selected in areas where suspected COCs are present. A rotary drill rig method will be used to collect soil samples at the deep boring locations. Subsurface soil samples (200 ft) will be taken at intervals of either 5, 10, or 20 ft depending on FSRs or other site-specific conditions or observations. In addition, a minimum of three locations will be sampled to investigate the lateral and vertical extent of surface contamination. The samples will be collected near the entrances to the building (edge of slab), at the injection well housing, and along the alignment of a suspected buried drain line. Surface and subsurface soil samples (0 to 5.0 ft bgs) will be collected and field screened for TPH and VOCs.

The initial Phase II investigation efforts will consist of further characterizing the site where COCs have been confirmed to be present. Step-out (both vertical and horizontal) sampling points will be established and samples will be collected during the Phase II sampling to delineate the extent of hot spots identified during Phase I. During Phase II, step-out sample locations will be selected based on biasing factors and Phase I results and located on three sides of the locations where COCs were detected. At each Phase II location, soil samples will be collected at the depth where COCs were encountered in Phase I and at 2 ft below the lowest depth where COCs were encountered. Confirmation samples will be selected as previously discussed. Depending on the results of the screening, additional step-outs will be performed, as necessary. Figure A.1-12 shows a generalized sampling plan at CAS 03-20-05.

A radiological survey of the building floor, interior walls of the holding tanks, and the interior walls of the well vault will be conducted to identify any hot spots. A hot spot on the concrete floor or the tank and vault walls will be defined as any reading exceeding 1,000 dpm/100 cm^2 over background. If hot spots are identified on the floor or walls, samples may be collected at those locations for waste determination purposes. The Site Supervisor has the discretion of selecting sample locations that best represent potential contamination.

A minimum of two surface soil/sludge samples will be collected from within the injection well, well vault, and holding tanks for the purpose of waste characterization and waste profile preparation. The Site Supervisor has the discretion of selecting or modifying the locations based on results of the



Source: Modified from Holmes & Narver, 1966

Figure A.1-12
Sample Location Plan for CAS 03-20-03 Injection Wells

planned radiological walkover survey. In addition, a sample will be collected of the liquid waste in each of the holding tanks, if present, and the injection well, if present. Samples will be used for waste characterization and waste profile preparations. Both soil/sludge and liquid samples will be analyzed for VOCs, SVOCs, TPH, PCB, radionuclides, total metals, and TCLP metals. In addition, samples will be analyzed for TCLP VOCs and TCLP SVOCs, if required.

Sampling will not be performed on the structural frame of the BOP building because it is not considered a source of continuing contamination; therefore, it is not part of the CAS.

A.1.9 References

AEC, see U.S. Atomic Energy Commission.

ASTM, see American Society for Testing and Materials.

American Society for Testing and Materials. 2000a. *Standard Test Method for Radiochemical Determination of Plutonium in Soil by Alpha Spectroscopy*, C1001-2000. Philadelphia, PA.

American Society for Testing and Materials. 2000b. *Standard Test Method for Plutonium in Water*, D-3865-02. Philadelphia, PA.

American Society for Testing and Materials. 2000c. *Standard Test Method for Strontium-90 in Water*, D5811-2000. Philadelphia, PA.

American Society for Testing and Materials. 2002. *Standard Test Method for Isotopic Uranium in Water by Radiochemistry*, D-3972-2002. Philadelphia, PA.

BN, see Bechtel Nevada.

Bechtel Nevada. 1996. *U.S. Department of Energy Nevada Operations Office Environmental Data Report for the Nevada Test Site - 1994*. Prepared by S.C. Black and Y.E. Townsend. Las Vegas, NV.

Bechtel Nevada. 2002. Aerial photographs of CAU 322, October. Nellis Air Force Base, NV: Remote Sensing Laboratory Photo Library.

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2002. Title 40 CFR, "Protection of the Environment," Parts 260-282. Washington, DC: U.S. Government Printing Office.

DOE, see U.S. Department of Energy.

DOE/NSO, see U.S. Department of Energy, Nevada Site Office.

EPA, see U.S. Environmental Protection Agency.

Edward B. Hendricks Associates. 1965. Engineering Drawing entitled, "Area 3, L.A.S.L. Post Shot Yard," 5 May. Las Vegas, NV.

Holmes & Narver, Inc. 1966. Engineering Drawing NV-35-82-01.1 entitled, "L.A.S.L. Post Shot Yard Floor Plan," As-Built, 12 January. Mercury, NV: Archives and Records Center.

Holmes & Narver, Inc. 1979. Engineering drawing entitled, "Area 3 Mud Plant," 1 April. Las Vegas, NV.

IT, see IT Corporation.

IT Corporation. 2002. CAU 34, CAS 03-25-03 file. Las Vegas, NV.

McArthur, R.D., and F.L. Miller, Jr. 1989. *Off-Site Radiation Exposure Review Project, Phase II Soil Program*, DOE/NV/10384-23. Las Vegas, NV: Desert Research Institute.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (Science Applications International Corporation) entitled, "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV.

NAC, see *Nevada Administrative Code.*

NBMG, see Nevada Bureau of Mines and Geology.

NCRP, see National Council on Radiation Protection and Measurements.

NNSA/NSO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

National Council on Radiation Protection and Measurement. 1999. *Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies*, NCRP Report No. 129.

Nevada Administrative Code. 2002a. NAC 445A.2272, "Contamination of Soil: Establishment of Action Levels." Carson City, NV.

Nevada Administrative Code. 2002b. NAC 459.9929, "Storage Tanks." Carson City, NV.

Nevada Bureau of Mines and Geology. 1998. *Mineral and Energy Resource Assessment of the Nellis Air Force Range*, Open-File Report 98-1. Prepared by J.V. Tingley, S.B. Castor, S.I. Weiss, L.J. Garside, J.G. Price, D.D. LaPointe, H.F. Bonham, and T.P. Lugaski. Reno, NV.

REECo, see Reynolds Electrical & Engineering Co. Inc.

Reynolds Electrical & Engineering Co., Inc. 1977. Engineering drawing entitled, "Mud Plant Distribution Power Plan & Detail," 6 May. Mercury, NV: Archives and Records Center.

Reynolds Electrical & Engineering Co., Inc. 1994. *Spill Report Status*, 24 May. Las Vegas, NV.

Sanders, F.W. 1965. *Health Physics Advisor's Report for Week Ending 4-18-65,* 19 April. Las Vegas, NV.

Stewart, J.D., U.S. Department of Energy, Nevada Operations Office. 1992. Memorandum to D.R. Elle (DOE/NV) entitled, "Transmittal of 45-Day Report for Two Diesel Fuel Releases at the Area 3 Mud Plant, Nevada Division of Emergency Management (NDEM) Case Number H9Z0225C," 23 April. Mercury, NV.

USGS, see U.S. Geological Survey.

U.S. Department of Energy. 1997. *Environmental Measurements Laboratory Procedures Manual*, HASL-300, 28th Ed., Vol. I. New York, NY.

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002. *Industrial Sites Quality Assurance Project Plan, Nevada Test Site, Nevada*, Rev. 3, DOE/NV-372. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 1996. *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243. Las Vegas, NV.

U.S. Department of Energy, Nevada Operations Office. 2001. *Corrective Action Decision Document for Corrective Action Unit 262: Area 25 Septic Systems and Underground Discharge Point, Nevada Test Site, Nevada,* DOE/NV--744-REV 1. Las Vegas, NV.

U.S. Environmental Protection Agency. 1980. *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA 600/4-80-032 (NTIS/PB80-224744; CD ROM; NEPIS/http://www.epa.gov/cincl). Washington, DC.

US Ecology and Atlan-Tech. 1991. *Environmental Monitoring Report for the Proposed Low-Level Radioactive Waste (LLRW) Facility, Ward Valley, California*. Auburn, CA.

U.S. Environmental Protection Agency. 1996. *Test Method for Evacuating Solid Waste Physical/Chemical Methods*, SW-846, 3rd Edition, CD-ROM PB97-501928GEI.

U.S. Environmental Protection Agency. 2002a. Integrated Risk Information System Web Page http://www.epa.gov/iriswebp/iris/index.html as accessed on 2 December.

U.S. Environmental Protection Agency. 2002b. *Region IX Preliminary Remediation Goals (PRGs)*. Prepared by S.J. Smucker. October. San Francisco, CA.

U.S. Geological Survey. 1975. *Hydrogeologic and Hydrochemical Framework, South-Central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site*, USGS-PR-712-C. Prepared by I.J. Winogard and W. Thordarson on behalf of the U.S. Atomic Energy Commission. Denver, CO.

U.S. Geological Survey. 2002. "USGS/DOE Nevada Water Use Wells." As assessed at http://nevada.usgs.gov/doe-nv/wateruse/on 7 February.

Appendix A.2

Project Organization

A.2 Project Organization

The NNSA/NSO Project Manager is Janet Appenzeller-Wing, and her telephone number is (702) 295-0461.

The identification of the project Health and Safety Officer and the Quality Assurance Officer can be found in the appropriate plan. However, personnel are subject to change and it is suggested that the appropriate DOE Project Manager be contacted for further information. The Task Manager will be identified in the FFACO Biweekly Activity Report prior to the start of field activities.

Appendix A.3

NDEP Comment Responses

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

1. Document Title/Number: Draft Corrective Action Investigation Plan for Corrective Action Unit 322: Areas 1 & 3 Release Sites and Injection Wells, Nevada Test Site, Nevada	2. Document Date: April 2003
3. Revision Number: 0	4. Originator/Organization: Shaw Environmental, Inc.
5. Responsible NNSA/NSO ERP Project Mgr.: Janet Appenzeller-Wing	6. Date Comments Due: May 15, 2003
7. Review Criteria: Full	
8. Reviewer/Organization/Phone No.: Greg Raab, NDEP	9. Reviewer's Signature:

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1) Page ii		The Section 5.3 Investigation-Derived Waste Management is missing from the Table of Contents. As this is a required section according to the FFACO format, it must be included. Although part 5.0 Waste Management has a discussion of Investigation-Derived Waste Management, the document does not follow the agreed upon format.	Section 5.3, Investigation-Derived Waste Management, of the CAIP for CAU 322 has been revised in accordance with the agreed upon FFACO outline.	Yes
2) Section 4.2, Page 39, 4th Sentence		"...unbounded..." clarify what is meant by "unbounded" contaminants.	Unbounded is in reference to the identification of COCs beyond the spacial boundaries of the site as defined in the Data Quality Objective (DQO) process and the Conceptual Site Model (CSM). The last sentence of the paragraph was modified to read, "Only unbounded COCs (i.e., those outside of the spacial boundaries) will be considered during Phase II sampling."	Yes

[a] Comment Types: M = Mandatory, S = Suggested.

Return Document Review Sheets to NNSA/NSO Environmental Restoration Division, Attn: QAC, M/S 505.

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